HOW TO BUILD, EQUIP AND OPERATE A COTTON MILL IN THE UNITED STATES

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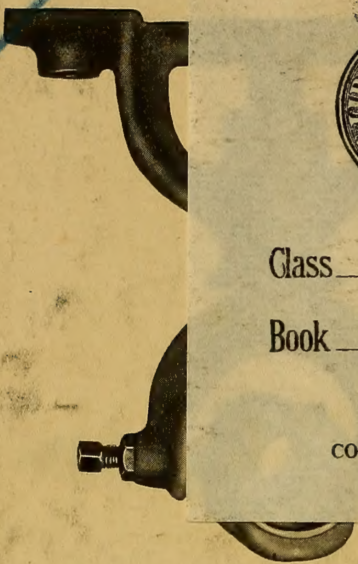

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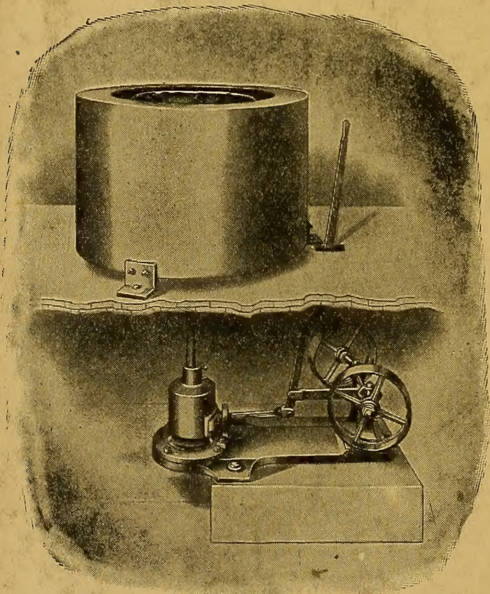

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How to Build, Equip and Operate a Cotton Mill in the United States

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PREFACE

THIS book is a collection of articles which have appeared in the American Wool and Cotton Reporter. The volume is divided into four sections, as follows: The articles in PART I consider the mill buildings and mill power plants. This section also contains much information relative to the power required by various cotton mill machinery and valuable suggestions regarding the building and equipment problems as met in both new and old cotton mills.

In PART II, the articles deal with mill administration, following the various processes of manufacture from the opening of raw cotton to the shipping of finished products. PART III contains general information regarding bleaching, dyeing, mercerizing and all kinds of finishing processes. PART IV deals with modern cotton mill cost systems, and PART V is an alphabetical index of the whole book.

The articles in this book have been prepared by mechanical engineers exceptionally familiar with the textile industry, by mill agents and superintendents, by expert designers, dyers and finishers, and by accountants and systematizers who have done much toward increasing the efficiency of the textile industry.

General Division

of

CONTENTS

Mill Construction
AND POWER

Many times in the past mills have been built with very little regard for economical production and low costs.

Choosing Mill Sites

Some mills have been built in places where practically no natural or artificial advantages were present, and were mere financial ventures, but happily this condition is not true in regard to the large plants being planned and built at the present time. A mill site is or should be chosen for its natural or artificial advantages, or possibly a combination of these two conditions in producing economically the fabrics of different grades. These advantages may be stated as follows:

First, on a river where water is available for power and other purposes by the building of dams and the use of water wheels.

Second, on the coast, so that advantage can be obtained by cheap transportation of materials and fuel.

Third, near a railroad centre where carrying charges are reduced by competition.

Fourth, in a section where other mills operate, so that the supplies of experienced help may not be too small.

Fifth, near the producing centres of material and fuel, so as to have a low first cost.

Power

At present, a mill to be run economically and successfully, and to compete with other mills, which operate on very small margins of profit must have a number of these conditions to make it successful, but if only one of these advantages be present, it must be under very good conditions to make a successful location. Power is a large and continuous part of a mill's expense, and to it the largest share of attention has been paid in the past, and to the selection of suitable sites many of the existing mills owe much of their present success.

The two large sources of power in mills are water and coal, and most of the large manufacturing cities are situated on rivers where power is obtained for operation, and where water can be used for the different processes of making cloth salable when woven. What the value of a site on a river depends upon may be given as follows: First and foremost appears the amount of water and evenness of flow throughout the year. If there is only a slight variation, this is a large advantage, but if the variation is large, then machinery may be stopped for a long period, and at a large loss in most cases. Where there is a variation, it is necessary to install a steam unit to make up the shortage of power when the water is low, and this, of course, necessitates an extra expenditure.

Water Privileges

The conditions which go into the total cost of power plant construction and mill construction on a selected site will depend to a certain degree upon the cheapness at which building material can be obtained. The value of a site on a river may also depend upon the shipping facilities, either present or planned, upon the condition of sanitation, such as a good supply of water for domestic purposes, upon the natural healthfulness of the location and conditions for a good sewerage system. Of course, the abundance or evenness of the river's flow depends upon the size of the river area drained, the total amount of rainfall, the character of the soil, and the presence of large wooded areas, which retard evaporation. The evenness of flow

also depends to a certain extent upon the size of storage basins, either in the natural form in the shape of lakes, or artificial in the form of dams or reservoirs. These regulate the flow by storing water in the wet season of the year for use during the dry season, and they also prevent sudden large rises in volume which waste a large amount of water. The St. Lawrence, because of the large area drained and the size of the lake storage, has so constant a level that any variation in flow is scarcely noticeable.

Details Considered

Information should be gathered in as large a way as possible, so that an approximate idea can be obtained of the cost of construction, or in other words, enough details should be obtained to show that the site selected has advantages which more than offset its disadvantages, and which will allow it to compete in the costs of production with mills making similar lines of fabrics.

If a site is to be selected where steam is to be the power used, then it is necessary to choose a place where cheap transportation charges will be apparent, both for fuel and material, and it is also necessary to consider the proximity to markets. Of course, with steam as a motive power, it is still necessary to have a good supply of water for domestic purposes for dyeing and also for boiler use. With a steam unit of some size, it is a fact that in many mills, unless extremely favorable conditions exist, steam power can be produced as cheap or even cheaper than water, because exhaust steam can be used for heating purposes. Steam power costs more in small units, but as economical results can be obtained in units of over 500-horse power as with the use of water. It is possible that steam has been used more in the past than it would have been through the lack of water powers with scope of the market and near the base of supplies.

Machinery Equipment Considered

Regardless of the location established, the principles of construction remain identical, excepting that portion which has to do with power, although, of course, details may vary according to different qualities of building material to be obtained and different circumstances of location, and to a certain extent by the kind of fabric to be manufactured. Mills are designed for the manufacture of a certain kind of fabric, and are built to receive the machinery necessary for the various operations of manufacture. The two main facts to bear in mind are the economical production of goods and structural firmness. Economy of production is obtained by having the various processes follow in succession as much as possible, so that a continuous journey is made from raw material to completed products. Enough space should be allowed for handling, but there should be as little waste space as possible.

Future Enlargements

It is also a good plan to give some consideration to future enlargements, so that if any additions should be planned, the system already working would join with the enlargements in the economical production of goods. In many mills the largeness of economy is measured by the simpleness of the working arrangement. Many mills have had their whole plant rearranged so that a more economical working arrangement could be obtained. Mills are built in a general way in these proportions for widths 46, 69 and 92 feet inside dimensions, or outside widths of 50, 73 and 96 feet, although some men make the widths 50, 75 and 100 feet, and this gives somewhat more room in the alleys. The distance between bays or the lengthwise distance is about ten feet. To give a good light, the height of the stories would be about 12, 13 and 14 feet, to correspond with the widths above given. Heights of 12 feet are rather low, but it is also possible to have them too high, because then the shafting and belts are out of convenient reach.

General Design

The width in a woolen mill is determined by the amount of space needed for a set of cards, or about 50 feet. When several mills are to be built, a uniform grade of stories should be made, so that bridges can be made which connect the different sections. High and narrow mills have rather gone out of use, and it is generally admitted that a mill of four or five stories is more economical, all things considered, than any other kind. A one-story mill has less vibration and more light, and is usually built for the weaving portion, while the other machinery is placed in another building. Of course, this makes better work to a certain extent, but the cost of construction is higher, and it is a large question whether it is enough of a saving to justify the extra expenditure.

Power Distribution

The placing and arrangement of the motor power should be given careful consideration, when steam is the motive power, because fuel at high cost leaves a large loophole for waste, unless power is distributed in the most economical manner possible, and it is certain that this distribution is to a large extent dependent on the construction used in the building. This construction should be stable in any reasonable loading of the floors, deterioration caused by vibration, atmosphere and wind, and should be built with due regard to the prevention of fires. As the risks grow large, the larger should be the margins of safety used, and the more pains taken in building.

Beauty of construction in mill building is of the least consideration, but the adaptation of means to the end, with each part symmetrically forming the whole structure, should result in beauty in architecture. When the result impresses one with a sense of fitness, then it is that a fundamental principle has been observed, for in a mill building, there should be a sense of strength and stability, and there should be nothing in the decorations which is not useful. No expense is added when material is put together, so as to make the best of everything, and utility and strength can be combined with taste and judgment, so that a pleasing and beautiful result will be obtained.

The Best Location

Before deciding upon the location for a new cotton mill, many conditions should be carefully taken into account and their relative importance given due consideration. It is well to compare the success of mills already in operation, but frequently two mills which are in the same city and engaged in similar lines of work show extremely different profits. Again, in some places where it seems desirable to locate there may not be any established concerns with which to make comparisons.

The ability to obtain sufficient and proper labor is of major importance. Systematic investigation along this line generally furnishes information fairly authentic, and prominent men of a city can always give valuable data concerning previous labor troubles in that locality.

Shipping Facilities

Shipping facilities affect the operating cost of a mill, year in and year out, and must be given great attention. All proposed railroad lines should be noted and future additions and changes in various transportation companies investigated. If supplies are to arrive by water the ownership of a private wharf will probably be a good investment, and if this is true, the possibilities of sending away the finished product by water must be likewise studied. At one time the ability to obtain water power was the chief consideration in choosing the new cotton mill site. To-day water power is being developed more than ever, but the introduction of the hydro-electric plant with its flexible system of power transmission has made natural water power a smaller consideration when deciding upon a location for the mill.

We will consider first the influence that the power department has upon the location of the entire mill. Although obtaining power is but one small part of cotton mill management it is a most important item. The cost of power continues every year and in building a new mill careful attention should be given to this detail that operating expenses may be reduced as much as possible. We do not mean that everything should be sacrificed in order to obtain power cheaply. In some instances labor questions and the cost of obtaining raw materials may make it wise to place a mill where power costs are higher than at places previously considered. However, the kind of power to be used and its probable cost should be thoroughly investigated.

Two Methods

Two methods of obtaining power present themselves. At the outset the management must decide whether it will be best to maintain an independent isolated power plant, or purchase power from a large central station. If the latter course is to be adopted, the mill will, of course, be electrically driven, but if an isolated plant is to be built, the power problem is still further divided, and the question of mechanical versus electrical transmission is introduced. With independent water-power plants comes also the necessity of placing the mill somewhere near an available water power. To summarize, the choice of power is divided first into two propositions, namely, independent power plants and large central stations. With independent plants power may be generated by water and transmitted mechanically or electrically; it may be generated by steam and transmitted mechanically or electrically, or some combination of all four methods may be used. We cannot overlook the gas and oil engine units, but these will be considered by themselves later.

Power Supply

If power is to be purchased from large central stations, a mill location near some prosperous power plant is desirable. By near we do not necessarily mean within the same city but simply within convenient reach of the plant's distributing system. With an independent power house there are many points to be considered which affect the location of the main mill. In the first place, if water power is to be utilized, the plant must be placed near some stream of water. In former times this meant that the entire mill must be placed directly upon the stream but now, by using electricity, the mill buildings may be placed some distance from the power house.

The use of water power in isolated plants does not therefore limit a mill's location in the way it did before the introduction of the hydro-electric plant, but it does very considerably restrict the selection of a mill site. The danger from floods which was an important consideration when all the buildings which used water power had to be placed upon the river's edge is now eliminated, but it is not economical to remove the isolated power house too far away from the main mill.

Steam Power

If steam power is to be used there are two conditions to be considered, both of which play an important part in the arrangement and location. Slow speed reciprocating engines may be installed and all power transmitted by belting and rope drives, or steam turbines may be directly connected to electric generators and power delivered to the various departments electrically. Either of these two methods demands a large boiler plant and the ability to receive and store large quantities of coal economically is a point which must not be slighted. In cases where the power is to be transmitted mechanically the power house should be as centrally located as possible, and allowances should be made for future extension in a way which will keep all additions near the power plant.

Water Supply

Mills which are operated by steam require much larger quantities of water than is ordinarily realized. Everyone knows that water is needed for the boilers, but the resulting expense if this water is all purchased from a municipal water company is sometimes overlooked. Water for use in steam boilers should be free from certain scale forming substances and it is most important to have the water analyzed carefully by an expert chemist. The American Wool and Cotton Reporter has already published some interesting facts concerning substances which cause serious boiler scale, and, although apparatus is upon the market for purifying feed water, it is much better to obtain the kind of water best suited for steam generation.

The advantages of locating near a supply of good, fresh water are of less importance with plants receiving their power electrically from hydro-electric stations maintained by other corporations. All textile mills require certain amounts of steam for manufacturing and heating purposes. The amount of steam and hot water required by mills doing their own dyeing, bleaching and finishing is large and they should be built near a water supply, even if power is purchased from a central station.

No Fixed Rule

The subject of central station power versus the isolated plant for textile mills is one upon which much valuable information has been published. It is not possible as yet to state any fixed rule regarding this matter and without the slightest doubt many cotton mills can to-day operate with greater economy by generating their own power, while others obtain better results from purchasing it. Power can be generated much more cheaply in large quantities than in small amounts, and there is every reason to expect large corporations, whose one aim is cheap development of power, to produce and transmit electricity for less money than it can be generated by the cotton mill, of which the power department is but one detail of a great and complex business.

We will consider some of the advantages derived from each system with the idea of simplifying somewhat the task of making the best choice. Careful consideration must always be given to existing conditions, for special cases change considerably the importance of the benefits to be gained.

Waste Heat

With independent isolated plants for cotton mills it is possible to utilize the waste heat from all parts of the mill. Steam which has been used in slashers, heating kettles, circulation pipes, etc., may all be returned to the boiler room and whatever heat has not been used may in various ways be saved. Mills doing color work use larger quantities of steam than those on white, and, therefore, with the former this factor is of greater importance.

There must be some system for heating the mill, and this as a rule makes a certain number of steam boilers a necessary equipment. As noted, steam is used for manufacturing purposes, therefore at least a part of the boiler plant is required during the summer as well as winter regardless of the power question.

Load Constant

Cotton mills usually run ten hours each day, and the load during this time is fairly steady. It costs less for steam power where the load is constant than it does for fluctuating loads. This means that power costs less per unit for the cotton mill than it does for street railway work for example; and the price charged by a central station furnishing power for both classes of work would tend to be higher than the cost of power for textile work alone would necessitate.

Auxiliary Apparatus

It is not considered necessary to have complete sets of auxiliary power apparatus in a power plant operated by the mill itself, for certain risks of shut-downs can be taken. This is not true with central stations, as they must at all times be ready to furnish power. This extra equipment to at least some degree balances the fact that large plants produce power more cheaply than smaller ones.

The cotton mill which is operated by power purchased from a central station is free to extend and enlarge its departments as much as it wishes without giving serious consideration to the power problem. The mill as a whole is much more flexible than if it maintained its own power house.

While it is true that isolated plants take the risk of shutting down when trouble occurs, is this risk expensive? Power from central stations is more reliable and as much or as little of it as is wanted may be used at any time.

Cost of Power

The one great question is that of cost. Is central station power cheaper than that delivered by private plants? Doubtless power can be delivered to-day from many large power companies cheaper than the actual cost of producing it in small isolated stations. In many of these instances, however, the cost of an isolated plant, as figured by the mill man maintaining it, will be below the price charged by the central station.

Two important conditions are accountable for this. First, the mill man invariably does not charge his power plant with all the "general expense" items that he should. Second, the management of central stations does not give due consideration to the fact that the expense of furnishing 5,000-horse power to, say, five customers is much less than furnishing this same amount to 500 customers.

Estimates Too Low

We do not mean that the cotton mill superintendent purposely figures the cost of his power plant too low. There are certain general items such as engineer's salary, cost of coal, water, equipment, etc., which are sure to be included in his figures, but how about the percentage of his own or his assistant's time that is used in the power department? How about the clerical work of filing away coal consumption and other engine room records? If a breakdown occurs, is the estimated monetary loss charged against power? There are no end of small expenses brought about by the power plant which are frequently charged up as "general expense" and not included in power costs. Mill owners have sometimes made the statement that they would rather pay 15 or even 25 per cent more for central station power than the cost entailed by the isolated plant. They do not mean this for one moment. What they do mean is that the estimated cost of operating an isolated plant is always lower than the true cost by 15, or even 25 per cent.

The cotton mill manager seldom figures any of the interest on the floating debt against cost of power. Money is nevertheless tied up in the coal pile and must be drawn from somewhere. It must also in some way earn its interest. This item is comparatively small, but it is worth consideration.

The removal of ashes is a point which is sometimes neglected in figuring the cost of power, although it is clear that this should be included. Depreciation should be carefully figured, not upon the time which the plant might last, but upon the probable time that it will be used. Many other small matters, such as time required in hiring men and purchasing coal, oil and other supplies, in the aggregate represent a considerable outlay, and if due allowance should be made for them, the estimated cost of power as furnished by the isolated plant would be nearer the correct value.

Wholesale Prices

Central stations have been extremely slow in realizing the benefits they might enjoy by selling power in wholesale quantities at fair wholesale prices. For several years they continued to base their costs upon retail prices only, forgetting, or at least ignoring, the decrease in distribution expense made possible by a few large customers instead of many small ones. Where wholesale prices were contemplated they were given up because the average cost per kilowatt hour was greater than the wholesale price. To-day central stations are beginning to realize that it is per cent on investment and not cents per kilowatt hour that means profit. For example, if a central station supplying a few large customers installs a network of wires and apparatus for handling small retail customers, the average cost to the station, per kilowatt hour will be increased. Even if the retail price is arranged to cover the increased expense, the average cost per kilowatt hour for current developed will be greater than formerly, but there is no reason why the wholesale purchaser should have his price increased. This confusion of wholesale and retail prices has greatly retarded the introduction of the central station power supply for textile mills.

Initial Expense

Building an independent power plant requires considerable initial outlay. This money is available for use in other branches of the business when power is purchased. A better arrangement of buildings can often be made when it is not necessary to include a power plant and in some instances the saving in floor space is in itself a point of importance.

At present, circumstances exist which make the isolated plant desirable in some instances, while in others, it is best to purchase power from some central power station. As noted, however, the central stations are just beginning to realize the advantages of furnishing power in large amounts, and while mills already owning well equipped power plants will probably continue to operate them, new cotton mills will find that the inducements offered by central power stations are increasing in number and in importance.

Grouping Textile Mills

One method of procuring power for textile industries is that of grouping several mills near one large power house. This practice may be worked out economically and it is often possible to have one or more of the mills near enough to the power plant to utilize much of the heat from condensed and low pressure steam. Again some of our large textile establishments use power in sufficient quantities and operate enough mills to require immense stations for their own use.

Granting that it is best for many new cotton mills to omit the isolated power plant and arrange to purchase power, the number of instances where the independent plant is advisable for medium sized cotton mills added to the importance of power station construction and equipment for groups of mills leads us to consider somewhat in detail the question of textile mill power plants. While much of our discussion will bear directly upon new power plants, some of the suggestions will be of equal importance to textile mills which are now being operated by plants out of date. Many of these could be placed on a much more economical basis by the introduction of simple improvements, the cost of which would often be exceedingly slight.

Power Plants

The American Wool and Cotton Reporter has already outlined the general arrangement of several textile mill power plants. It has not wished to criticize severely even the most undesirable methods of obtaining power, but it has endeavored to speak a word of praise whenever op-

portunity offered. The careful study of the articles referred to supplemented by matter which will continue to appear, must of necessity call attention to possible improvements in existing power plants and should also guard against costly mistakes in connection with new work. Some rules hold true for all textile establishments, but there are numberless other important ones which are controlled by existing conditions.

We have already mentioned the importance of placing the steam power station where coal may be obtained cheaply and have likewise laid stress upon the advantages of locating near a lake, pond or river containing water suitable for boiler feed and condensing purposes. Water which will not form scale within the boilers is a great asset, and a sufficient supply of water to handle satisfactorily all condensing apparatus reduces the cost of power. From 15 to 20 per cent of the fuel used by a non-condensing engine will be saved if it is operated with a condenser. For each pound of steam exhausted by an engine the condenser will require 30 to 35 pounds of water, so it at once becomes clear that for this work the quantity of water required is often large.

Conveying Coal

The expense of handling coal after it has been delivered to the mill is frequently much too great. It is often advisable to install a mechanical system for bringing coal from the storage bin to convenient places in front of each of the boilers. Systems have been designed for all kinds of work and are not expensive. Often the same conveying arrangement removes the ashes and carries them to a convenient bin or pile, as conditions may make desirable.

At some plants coal can be stored in bunkers directly in front of the furnaces. In these plants a trestle may be built from which the bunkers may be filled by gravity directly from the freight cars. Some of the various methods which may be employed in handling coal will be taken up more at length later, but we wish right here to emphasize the fact strongly that our present textile mills have a wide field for reducing power costs along the one line of coal and ash conveyance.

The Power House

The question of construction and arrangement most suitable for an independent textile mill power station is important. The subject divides itself readily as follows: 1. General rules applicable for all textile mill power plants. 2. Water power stations transmitting power mechanically. 3. Hydro-electric stations. 4. Steam power plants using reciprocating engines and mechanical power transmission. 5. Turbo-electric stations using steam turbines and electric generators.

All power plants should be built as nearly fireproof as possible. With cotton mills using water for the entire power, steam boilers are necessary for heating and manufacturing purposes, and should be installed in a fireproof building. Reinforced concrete makes satisfactory walls for power plants, but at the present time the tendency is to build the walls of brick and support the roof by steel trusses. The steel trusses should be covered by some type of roof which is fireproof. Wooden roofs covered with tar and gravel will be found at many stations, but in most cases it is wise to use concrete, sheet steel, or some type of tile.

Good substantial cranes should be installed in every power house to assist in placing or repairing machinery. The methods of supporting these cranes demand consideration at the very outset. Some engineers prefer to build the brick walls sufficiently heavy and strong to hold the roof and crane, while others supply steel columns for this purpose, which are set upon specially designed foundations. This latter method is preferable, as a rule, and the columns may be imbedded in the brick walls, so that they are out of sight and in no way interfere with the free floor space.

The Engineer

The design of power house should be worked out by a structural engineer, and the matter given by the American Wool and Cotton Reporter is in no way intended to make the services of an engineer less necessary. Our intention is to familiarize the reader with important points, which are, or should be, considered by the engineer, so that new buildings and equipment may be obtained by the mill man understandingly. Only by understanding, in at least a general way, the advantages of certain engineering principles, is it possible to decide correctly upon the type of plant required.

Foundations

Proper foundations are not always obtained. Work buried under ground sometimes seems less important than other considerations, but poor foundations are sure to mean poor results. No serious accidents may happen, but the machinery will require more attention that the bearings may be kept in line and free from unnecessary friction losses. Uneven settlement of the brick walls is liable to cause ugly cracks in the structure, which are undesirable, if not actually dangerous.

The character of the soil underlying the proposed site for a power house should be carefully and thoroughly examined. If there is the slightest doubt concerning the condition of the soil, one or more experts should be called in and their opinions ascertained. No rules of the bearing power of soils can be given which will cover all cases, but the following, taken from the New York Building Code is of interest: "Different soils, excluding mud, at the bottom of footings, shall be deemed to safely sustain the following loads to the superficial foot, namely: Soft clay, one ton per square foot; ordinary clay and sand together, in layers, wet and springy, two tons per square foot; loam, clay or fine sand, firm and dry, three tons per square foot; very firm, coarse sand, stiff gravel or hard clay, four tons per square foot."

Solid Rock

Solid rock foundations will stand almost any amount of loading, but all loose rock should be removed. In building upon solid rock, its surface should always be stepped off and concrete used to insure vertical downward pressure. Within a power house there is much heavy machinery, for which large foundations are needed, but the principles to be considered are so similar to those met with in regular building foundations that we will postpone the further discussion of this subject until we take up foundation questions as applied to the main cotton mill.

Inside Arrangement

Costly mistakes may easily be made in locating the apparatus within a new power house. The boilers should always be placed near the turbines, or engines, that losses in the steam pipe line may be small. The arrangement should also be such as to permit the installation of new units without moving any part of the original equipment. Where it is possible, it is best to have the boiler-room and engine room in one building, separated from each other by a fire wall. The boilers should be arranged in a row, with the rear end near the dividing wall. The engines or turbines may also be placed in a row parallel to the dividing wall, and if it becomes necessary to enlarge the building, it will be possible without in any way interfering with the units which are in use.

It is best, in most cases, to have the boiler room floor on the level of the outside ground, and that of the engine room six or twelve feet higher. By this arrangement, the room under the engine room may be used for condensers, pumps, heaters and other auxiliary apparatus. Local conditions sometimes make it wise to place the engines, or turbines, upon the same floor with the boilers. When this is done, it becomes necessary to have a pit under the ground floor for the auxiliary apparatus, and these pits should be avoided. There is always consider-

able vibration in a power station, and it will be found hard to keep surface water and water contained in the soil from leaking into the pit. Concrete walls have been built, but the vibration is apt to cause cracks which will allow water to come in. Again, with the two rooms on the ground floor, much of the piping will necessarily be covered over, and therefore, be much harder to get at in time of trouble or in making changes than if it were in a regular basement.

Handling Coal

In a recent issue of the American Wool and Cotton Reporter it was stated that the field for improvement along the line of handling coal at the mills was large. In building a new power house, the economical handling of coal should have careful study and consideration. The expression, "coal conveying system," to some mill men means an expensive contrivance good for use in large central stations only. This is a sadly mistaken idea, and, we trust, one which will soon be corrected.

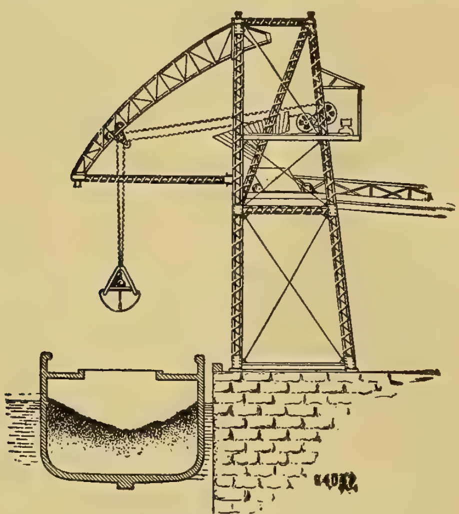

Fig. 1. Coal Elevator and Two-Chain Shovel.

A simple system, which is in use at the Narragansett Mills in Fall River, was explained some weeks ago in the American Wool and Cotton Reporter. The system is not expensive to operate and the initial cost is small. The idea utilized for supplying the firemen with coal directly in front of each boiler is one which is often of value. By building coal bunkers just outside and against the boiler house wall the fuel falls by gravity through openings provided in front of each furnace.

From the Wharf

If coal is to be received by barge loads at a private wharf, a belt or bucket conveyor can often be arranged to take the coal directly from the unloading apparatus and deposit it in the storage bunker. Figure 1 is a sketch of a self-filling bucket and elevating apparatus used for unloading coal barges. The arrangement indicated shows a small industrial railway car for taking the coal from the wharf to the power house, but any type of bucket or belt conveyor can be used instead of the industrial railway where advisable. Sometimes it is best to build a railroad trestle so that the coal cars may be delivered at a point where they can be unloaded directly into the storage bins. This same trestle arrangement can be used for unloading regular freight cars, if the coal is received by rail, or it may be used in connection with small cars of industrial railway systems, such as often convey fuel from a wharf to the mill.

At the Narragansett Mills the floor of the boiler room is much lower than the street level, so that coal is delivered from teams into a coal bunker built against the boiler-house wall. No machinery is needed for handling the coal, but it falls by gravity directly in front of the boilers. A conveyor runs through the ash pit under each boiler and carries the ash to an elevated bin, from which it is readily removed by carts. We refer to this simple arrangement to show that it is possible to greatly reduce the cost of handling coal and ash, if the matter is given a fair amount of thought and attention.

Many Good Systems

Local conditions generally decide which of many good systems is the one most suitable, and for this reason the question should be settled before construction work is started upon the station itself. When it is not advisable to build a trestle, and the coal is received in cars or teams on about the same ground level as the boiler room, coal storage bunkers are frequently placed over the boilers. They are filled by an endless chain of buckets, and by means of spouts fuel is delivered as needed, either in front of the boilers or into automatic stokers, as the case may be. The same conveyor may be arranged to pass under the boiler grates so as to remove the ashes and carry them to a convenient storage pocket, from which they can be drawn by gravity into carts or cars. Figure 2 shows a section through a power house, and indicates the way a conveying system may be arranged to handle both coal and ashes. The conveying buckets may be dumped at any desired point, and can be arranged to run in either direction.

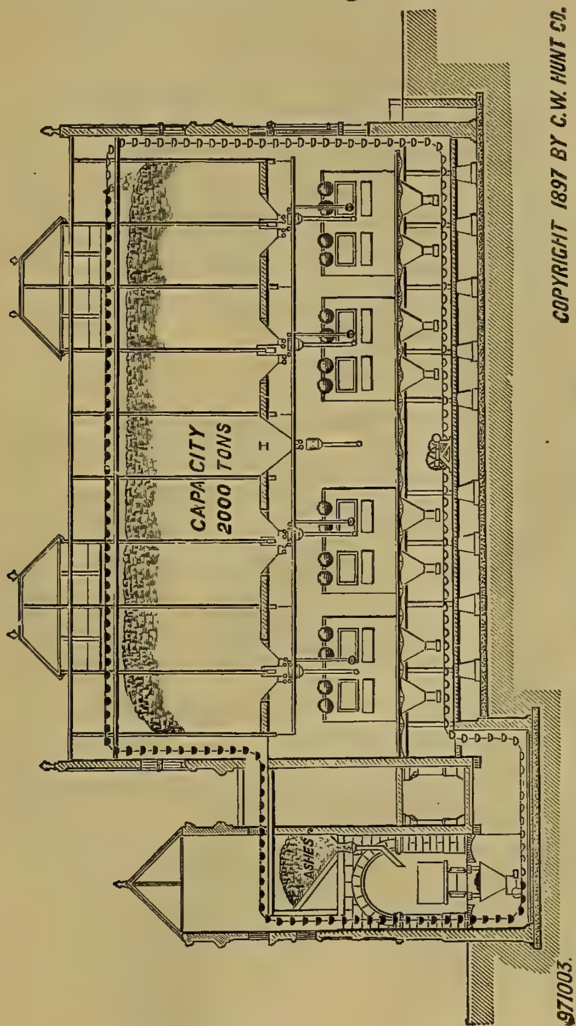

Fig. 2. Section through Boiler House Showing Coal Conveying Buckets.

With systems which have the buckets swung freely on pivots, it is essen-

tial that the buckets be filled evenly to prevent spilling. Figure 3 illustrates one style of a spout filler which fills the buckets evenly and prevents the conveyed material from dropping between them. The filler has a series of bottomless shells which fit over the buckets of the conveyors and distribute the material evenly as they are drawn out.

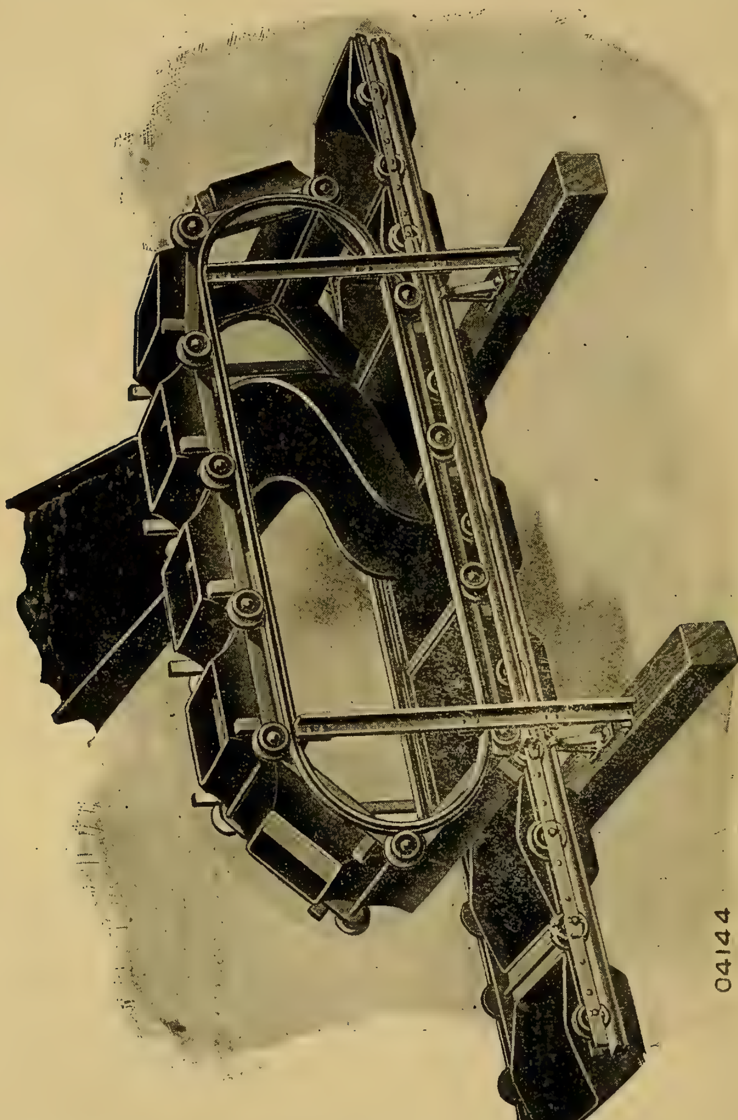

Fig. 3. Spout Filler for Coal and Ash Conveyor.

When coal is delivered to a plant by boat, it is frequently elevated by a self-filling bucket and raised by a boom to an elevated coal hopper in a tower on the wharf. The coal passes through a crusher to reduce the size of all large pieces, and then falls into automatic weighing scales. From the scales it falls upon a conveyor and is delivered to the bunkers over the boil-

ers. Frequently, large storage bunkers are built outside of a power house, these being filled by conveyors, while a second conveyor extends from the storage bunker to the smaller ones over the boilers.

Important Facts

One-fifth of the entire steam power used for manufacturing purposes in the United States is to-day operating textile mills, and, according to a statement made by John S. Lawrence in a paper read before the National Association of Cotton Manufacturers last April, the coal consumption of the United States is over one-third that for the entire world. It is interesting to quote somewhat further from this same paper as follows: "In 1908, New England's total coal consumption was about 24,000,000 tons of 2,240 pounds each, for which over $100,000,000 was paid. The exact statistics are not obtainable, but it is estimated that there was an increase of approximately 100 per cent in the steam coal consumption in the ten years from 1898 to 1908. Of this enormous quantity, approximately 8,600,000 tons were anthracite and 15,400,000 tons bituminous coal. Of this total, 16,000,000 tons were discharged at New England ports, while 8,000,000 tons were received all-rail from the mines."

Where water power is depended upon entirely, and steam is used only for manufacturing purposes and heat, it is not necessary to locate the water wheels near the steam plant. If the water power is to be transmitted to the mill by belts and shafting, the main consideration is that of well-designed drives. The wheel-house location is rather definitely fixed by the natural water power which is to be utilized, but there is often some choice. Future additions to the mill must be considered, and the water turbine located so that the main drive will be as central as possible, in relation to the machinery it is to operate.

Hydro-Electric Plants

Hydro-electric power stations should be placed where a maximum amount of power may be obtained from the stream in question, with as little expense as possible. We do not mean that the initial expense should be considered alone, for the future operating costs must be estimated and included. As already stated, steam boilers require large amounts of water, and in many instances, mills receiving their power from hydro-electric stations find it advisable to locate the boiler plant in the same building. The best location for the water wheel is the major consideration, and the flexibility of electric transmission makes it possible to remove the power house some distance from the main mill, without increasing materially the transmission losses.

Steam Plants

Steam power plants depend upon the boilers for their power, and the relative location of the engine room and boiler room has been outlined under the subject of "General Rules for all Textile Mill Power Plants." If steam engines are to drive the mill mechanically, special attention must be given to the matter of location with respect to the mill itself, while if the power is to be transmitted electrically, this is not necessary. The importance of handling fuel cheaply, and of designing the power station so that auxiliary apparatus may have the proper room and location, holds true both for steam and turbine installations, and those where steam engines are used.

Motor Rating

In determining the required capacity for any electric motor, it is much better to slightly underload it than to err in the other direction. A few years ago, makers of electrical machinery gave ratings which allowed an overload of 25 to 33 1-3 per cent without causing the slightest trouble. To-day this is not the case, and motors should be provided sufficiently large to eliminate all troubles of this char-

acter. Good motors, as rated at present, will withstand overloads for short intervals but will cause excessive heating if the heavy load is carried continuously. All spinning rooms are hot normally because of frictional heat. If overloaded motors are used, they will throw off additional heat which will make it almost impossible to maintain proper temperatures in the summer time. The amount of heat produced by a number of overloaded motors is much greater than one would expect who has not had the chance to actually observe it.

Pickers and Openers

In a paper recently read by Meldon H. Merrill before the National Association of Cotton Manufacturers, much interesting and valuable information was brought out concerning the electric drive as used in the textile mills. As mentioned by Mr. Merrill, many mills now drive the picking machinery by individual motors fastened directly to the machine framing. The pickers and openers were among the first of the textile machines to be individually driven, and there is therefore more data on hand concerning their power requirement than for most of the other machinery. For general use, the table biven in a previous issue may be safely used—remembering, however, all allowances for special conditions.

Power for Cards

In the card room, the group drive is used in preference to individual motors. As stated in Mr. Merrill's paper, the carding is a continuous operation with practically no stops, except for grinding, and it does not present the attractive features for direct drive that are obtained with some of the other processes. Manufacturers have made tests upon their cards to determine the power required, from which the average values shown in the following table have been selected:

POWER REQUIRED FOR REVOLVING TOP FLAT CARDS.

(Temperature, 70 degrees F.; relative humidity, 65%; revolutions per minute of cylinder, 165.)

Pounds production per day of 10 hours. 40 in. mach.	45 in. mach.	Horse power. 40 in. mach.	45 in. mach.	Weight of caid sliver in grains per yard.
72	80	0.8	0.8	36
81	90	0.8	0.9	38
90	100	0.9	1.0	40
99	110	1.0	1.1	46
108	120	1.0	1.1	48
126	140	1.1	1.2	52
133	148	1.1	1.2	56
142	158	1.2	1.3	60
159	177	1.2	1.4	64
171	190	1.3	1.4	68
180	200	1.3	1.5	72
198	220	1.4	1.5	76

Combers

The power used by a six-head comber is about 0.5-horse power, while an eight-head machine requires 0.7-horse power. Sliver lap machines need 0.5-horse power, and for the ribbon lap machine one-horse power should be provided. Drawing frames frequently require excess power on account of poor leveling. There seems little reason why these machines should not be kept level, but it is often wise to investigate this matter. When in proper condition, one-horse power for every six deliveries will be needed if ordinary rolls are in use. Machines having metallic rolls generally require slightly more power, say one-horse power for every five deliveries.

Speeders

So many different conditions affect the power used by speeders and spinning frames that it is impossible to state any definite values as the ones most correct. The introduction of the individual motor drive, in connection with ring spinning, has enabled us to obtain some additional information for these machines, but the available reliable data concerning speeders is more limited. Some years ago, the Woonsocket Machine & Press Company made a fairly complete series of tests, showing the horse power required to drive slubbers, intermediates, roving frames, and jack frames. The following table

gives some of the results thus obtained:

SPEEDERS.

(Temperature, 76 degrees F.; relative humidity, 65%.)

Frame.	No. of spindles.	Size of bobbins in inches.	Gauge in inches.	Revolutions of spindles per minute.	Number of roving.	Spindles per horse power.
Slubbers	48	12x6	10	660	0.50	48
Slubbers	48	11x5½	9	657	0.60	58
Int'rm'd't's .	108	9x4½	6½	938	1.47	62
Int'rm'd't's .	90	9x4½	6½	969	1.47	52
Rov. fram's.	160	7x3½	5¼	1207	4.75	99
Rov. fram's.	160	7x3½	5	1428	5.10	87
Jack fram's.	160	6x3	4½	1520	8.33	89
Jack fram's.	200	6x2½	4¼	1538	15.00	104
Jack fram's.	200	6x2½	4¼	1480	15.00	114
Jack fram's.	200	6x2½	4¼	1477	15.00	114
Jack fram's.	200	6x2½	4¼	1446	15.00	111

In consideration of results given by other machine builders, the following values are fairly good averages for general use: Slubbing frame, 45 spindles per horse power; intermediate frame, 55 spindles per horse power; roving frame, 87 spindles per horse power, and jack frames, 100 spindles per horse power.

Ring Spinning

Various power losses in the spinning frame were explained at some length in a recent issue of the American Wool and Cotton Reporter, but it is well to speak once more of this in connection with the amount of power required to operate these machines. Considerable stress was laid upon power losses caused by excessive band tension, but little was said concerning the size of the band itself. This point is important. A large band produces more air resistance and consumes more power at the same tension. The Draper Company have made actual tests of the power added per pound increase of band tension. Although there is little excuse for the use of large bands on ordinary spindles, results are shown in the following table obtained from tests upon both kinds:

Revolutions.	Horse power per spindle. Bands about 120 to the pound.	Bands about 80 to the pound.
At 1000 R. P. M. each lb. of band tension adds..	0.00017	0.00027
At 2000 R. P. M. each lb. of band tension adds..	0.00035	0.00050
At 3000 R. P. M. each lb. of band tension adds..	0.00055	0.00065
At 4000 R. P. M. each lb. of band tension adds..	0.00075	0.00090
At 5000 R. P. M. each lb. of band tension adds..	0.00095	0.00115
At 6000 R. P. M. each lb. of band tension adds..	0.00120	0.00140
At 7000 R. P. M. each lb. of band tension adds..	0.00145	0.00170
At 8000 R. P. M. each lb. of band tension adds..	0.00170	0.00200
At 9000 R. P. M. each lb. of band tension adds..	0.00200	0.00230
At 10000 R. P. M. each lb. of band tension adds..	0.00230	0.00265
At 11000 R. P. M. each lb. of band tension adds..	0.00260	0.00300
At 12000 R. P. M. each lb. of band tension adds..	0.00295	0.00340

An Interesting Test

At the first glance, the above figures seem extremely small and unimportant, but it must be remembered that they represent the increase in power for one spindle. Another series of interesting tests carried on by the Draper Company had for its object the determination of the extra power required to overcome certain undesirable conditions present in actual spinning rooms. Cramped cylinders, tight bands, poor oil, dirty spindles, poor bobbins, heavy travelers or rings out of centre, and poorly oiled and adjusted rolls were all frequently found, and tests were made to determine the power directly chargeable to them. Some of the results from this series of tests are given below.

Extra power required, H. P. per spindle.	Cause.
0.00030	One cramped cylinder.
0.00185	Band pull increased to three pounds.
0.00200	Cheap, low gravity oil.
0.00300	Dirty spindles.
0.00030	Poor bobbins.
0.00050	Too heavy travelers, or rings out of centre.
0.00200	Rolls poorly oiled, tightly fitted, or too heavily weighted.

The sum of the above extra power amounts to nearly as much per spin-

dle as is necessary to drive the same when in proper condition, and spinning frames which should require one-horse power for every eighty spindles have been found using one-horse power for every fifty spindles. With proper care and attention, ring spinning frames will require approximately the power shown below:

POWER REQUIRED FOR RING SPINNING FRAMES.

(Temperature 76 degrees F.; Relative Humidity, 50%; Band Pull, Two Pounds.)

WARP YARN (Standard Warp Twist).

No. yarn.	Diameter of ring. Inches.	Length of traverse. Inches.	Front roll revolutions per minute.	Spindle revolutions per minute.	Cylinder revolutions per minute.	No. of spindles per H. P.
6	2	7¼	161	5,900	814	85
8	2	7¼	158	6,700	920	74
10	2	7¼	154	7,250	1,000	68
12	2	7	150	7,750	1,069	76
14	2	7	146	8,100	1,124	72
16	2	7	141	8,450	1,166	70
18	2	7	138	8,750	1,207	72
20	2	7	134	8,950	1,280	74
24	2	6½	125	9,200	1,280	76
28	1¾	6½	120	9,500	1,140	76
32	1¾	6½	114	9,500	1,140	78
36	1¾	6½	108	9,700	1,164	78
40	1⅝	6	106	9,700	1,164	80
45	1½	6	100	9,700	1,164	83
50	1½	6	94	9,700	1,164	86
60	1½	6	86	9,500	1,140	90
70	1½	6	80	9,500	1,140	94
80	1½	6	76	9,300	1,130	100
90	1⅜	5½	72	9,100	1,090	108
100	1⅜	5½	66	8,700	1,044	114
110	1⅜	5½	64	8,500	1,020	127

FILLING YARN (Standard Filling Twist).

No. yarn.	Diameter of ring. Inches.	Length of traverse. Inches.	Front roll revolutions per minute.	Spindle revolutions per minute.	Cylinder revolutions per minute.	No. of spindles per H. P.
6	1½	7½	178	4,800	662	142
8	1½	7½	175	5,450	752	140
10	1½	7½	171	5,950	821	125
12	1½	7	166	6,350	876	122
14	1½	7	162	6,700	924	120
16	1½	7	158	6,950	959	116
18	1½	7	154	7,200	992	110
20	1½	7	150	7,400	1,021	98
24	1½	7	144	7,800	1,070	87
28	1⅜	6½	140	7,900	949	86
32	1⅜	6½	135	7,900	949	88
36	1⅜	6½	129	7,900	949	90
40	1¼	6	122	7,900	949	90
45	1¼	6	115	7,900	949	91
50	1¼	6	109	7,900	949	93
60	1¼	5½	100	7,900	949	97
70	1¼	5½	92	7,800	936	100
80	1¼	5½	87	7,700	924	104
90	1¼	5½	80	7,400	888	110
100	1¼	5½	75	7,200	864	117
110	1¼	5½	70	6,900	830	132

Twisting and Spooling

Dry twisters require about the same power as warp spinning frames when working on the same numbers of yarn; while, for wet twisters, these values should be increased 10 per cent. The power needed for spoolers varies greatly, and while conditions requiring one-horse power per 300 spindles are sometimes obtained, the value 225 spindles per horse power is a safer average.

Weaving and Finishing

With mule spinning, 90 to 125 spindles may be operated per horse power. Warpers require about one-quarter to one-half of one horse power per machine, slashers one and one-half horse power, plain 40-inch looms one-quarter of one-horse power, and wide 92-inch looms about one-horse power. A fair average for reels is 250 spindles per horse power, for brushers and shearers three-horse power per machine, and for cloth folders one-half of one-horse power.

Compressed

While speaking of the saving gained by keeping machinery clean and in good running condition, we may well mention here the rapidly increasing use of compressed air for cleaning textile machinery. Compressed air has been used for this purpose, in a small way, for some time, and during the last few years, experiments have been made which prove plainly many advantages obtained with it. Operatives are inclined to waste large quantities of air by removing nozzles and using the open hose for various unnecessary purposes, but this can be avoided by having special nozzles fastened to the hose in a way to make their removal by operatives impossible. Not only would the extravagant use of compressed air greatly tax the compressors, but large amounts of lint and dust would be raised. Some mills have provided reducing valves in the air pipe, in addition to the special nozzles, and in this way have elimi-

nated troubles caused by too large air openings.

Special Nozzles

At first, it was thought that the equipment necessary to provide enough air for cleaning spinning frames would make the practice impracticable. This would no doubt have been true had it not been discovered that a jet of air from a small aperture at the end of a long, thin tube would do much more and better work than a powerful blast from a comparatively large nozzle. The long, thin tube makes it possible to apply the air exactly where needed, and the dirt is removed by the small jet without blowing lint and dust upon the other machines, as is often the case when large volumes of air are used. Spinning machinery may be cleaned while running without fear of "spinning in" lint, and better results are obtained without the expensive losses from stoppage.

Driving the Spindles

Very few textile mills realize the importance of giving careful attention to the power used for driving the spinning frame spindles. The amount used to rotate one spindle is not large, even in the worst cases, but when we multiply this by many thousand the amount used is worthy of careful consideration. Any changes which will decrease the horse power per spindle are worth trying. The power consumed in causing a spindle to rotate is used to overcome friction. This friction varies greatly according to the type and size of spindles used, but in all cases care should be taken to reduce this to a minimum. No spindle can be made exactly straight, round and smooth, and the bearing is bound to be more or less rough. This causes friction, which increases with the weight supported and which will cause serious trouble unless kept properly supplied with oil. The load caused by a spindle is of such a nature as to throw its centre of gravity somewhat out of line and this brings about a centrifugal force, which increases both air resistance and bearing friction. The pull of the traveler also has to be overcome, and, last but not least, the lateral friction brought about by the pull of the band.

Eccentricities of Power

The amount of power required to overcome each of the several resistances noted varies greatly with the quality of the work performed, the speed of rotation and the general construction of the spindle itself. One principal element of power consumption is the lateral friction caused by the pull of the band, and in general practice today it is equal to a direct pull varying from a quarter of a pound to, at times, eight pounds. In some cases this pull varies from two to four pounds, while one pound would be ample if same could be constantly maintained. Moisture changes, however, affect these bands greatly, causing a considerable change in their lengths and for this reason they are ordinarily put on tight enough to take care of the variations. In addition to changes in bands from moisture in the atmosphere, oil too may be thrown upon them by the spindles, and considerable contraction is liable to take place while the machines are not in use, as during nights and week ends. A rain storm sometimes increases the power required by a spinning frame as much as ten per cent, and frequently even greater increases in power are noted when frames are first started after standing during the week end or even over one night.

Overseers of Spinning

These changes are hard ones to remove, and it is generally necessary to run the bands rather tight. Not enough attention, however, is given to the amount of this extra pull. Spinning overseers are rarely called to task for using too much power, while they are severely reprimanded if loose yarn is produced. This, of course, causes the

boys who tie the bands to make them in all cases too tight rather than too loose. It is true that loose yarn is not wanted but it is also true that the mill manager does not wish to burn extra tons of coal each year simply to overcome excessive and unnecessary friction.

The Fit of the Spindles

The friction of the spindle in its bearing depends upon whether it runs tight or loose. Many modern spindles have what is known as an "adjustable fit" and where this is provided its advantages should be carefully utilized. Instances have been found where a large excess of power has been daily wasted on account of failure to properly adjust the fit of the spindles. It is customary in starting up new machines to have the bearings adjusted rather close, for this causes the spindles to run steadier. As the bearing wears it requires less power to turn the spindles, provided other points which cause friction are carefully guarded against. The metal worn away will settle in the bottom of the spindle bearing, thicken and clog the oil, and in every way make spindles run hard unless at the outset large quantities of good oil are used. By large quantities we mean an excess so that the powdered metal will be actually flooded out of the way.

Careful attention should always be given the bands used in driving spindles, these should not be kept too tight. Proper oil used freely will save much money even if the price of same is higher than the kind now used. If spindles have adjustable fits they should be kept in proper adjustment; do not have bearings too loose but still have them loose enough to prevent excessive friction. Dirt must be kept from bearings as much as possible and if it is present to any considerable extent it will pay to clean the spindles thoroughly.

Measuring the Power

In testing the power required by machines in a textile mill several methods of procedure present themselves which are more or less valuable according to existing local conditions. In some cases the transmission dynamometer fills the requirements better than anything else, but in other cases the machines are driven by electric motors and accurate results are obtained by use of wattmeters. Some mills are arranged in such a way that by obtaining the power required to operate a certain room very valuable data is obtained. Perhaps the room may be driven electrically, in which case the wattmeter comes into use, but often this is not the case and results are obtained by use of a steam engine indicator similar to the one shown. By determining the power necessary to run the engine when driving the room in question and subtracting from this result the power needed to drive the engine and shafting alone, we obtain the power used by all of the machines in the room. Again, we may determine the power used by each machine by removing the belts from one machine at a time, indicating the engine as each machine is removed from the total load.

The Engine Indicator

There are to-day few engineers who do not know more or less about an engine indicator, and still many of them continue to look upon it as a useless contrivance made for the theoretical man and for which they have no need. The makers of steam-engine indicators are doing all in their power to show mill managers the advantages which may be gained by the use of an indicator and we are glad to find that the number of engine rooms without a set of indicators is fast growing smaller.

The steam engine indicator, as invented by James Watt, was for a long time kept secret and was in its early form so crude that its value was decidedly limited and restricted. Today, however, the instrument is one of great value and to a rapidly increasing number of mill owners and engi-

neers is the "watchman of the engine room."

The indicator shown is but one of many makes and styles, all of which, however, differ by small details, very important, perhaps, but not affecting the general working principles of the mechanism. A piston of a carefully determined area is placed inside a smaller cylinder, so that its motion up and down may cause as little frictional resistance as possible, and still fit tight enough to prevent any considerable amount of steam from leaking between it and the cylinder. One end of this cylinder is open and made to connect with the steam space inside the engine cylinder, so that the same pressure is exerted upon the small piston of one indicator as is applied to that of the engine. A spiral spring of known elastic force is arranged to resist the upward motion of the small piston—due to the steam pressure—so that a certain motion of the piston corresponds to a definite known pressure. This motion is conveyed by a small piston rod which comes out of the top of the indicator cylinder and is fastened to a system of levers similar to those shown in our illustration. These levers are arranged to give a vertical motion to the pencil point, shown near the cylindrical drum, and the amount of this motion bears a constant ratio to that of the piston.

Simple Calculations

The cylindrical drum just mentioned has metal clips arranged upon it so that a piece of paper may be quickly fastened around its surface. This drum is fastened to the cylinder of the indicator in such a way that the pencil point may be moved in contact with it and thus mark upon the paper. By means of a string fastened to the engine crosshead and a spring upon the indicator the drum is given a rotary motion coincident with and bearing a constant ratio to the movement of the engine's piston. By placing the pencil point against the paper covered drum a line is drawn indicating the pressure within the engine's cylinder at all portions of the stroke. During one-half of the stroke the line represents the pressure moving the piston forward and during the other half it indicates the pressure against which the piston must return. By shutting off the steam from the indicator and submitting it to atmospheric pressure a line is drawn upon the paper representing the pressure of the atmosphere. This shows at a glance whether the pressure within the cylinder at any desired portion of the stroke is greater or less than that of the atmosphere. Knowing the average pressure—known as the "mean effective pressure"—upon the piston, the horse power may be obtained by simple calculations.

The usefulness of a correct engine indicator diagram goes much farther than simply giving the amount of power developed by an engine. Wrong valve settings are shown and the necessary changes clearly indicated. The positions of the piston at admission, cut-off, release, and compression are obtained. The adequacy of the ports for admitting and releasing the steam is determined and a very detailed study of the engine's action is represented by the indicator diagram.

Verifying the Test

The simplest machine in a textile mill needs careful use and attention in order to do its work in the proper way. The amount of twist given to yarn might seem a very simple thing in itself, and yet how important a part this plays! The same principle holds true with the steam engine indicator and unless small matters are considered it will tell a story differing greatly from the correct one.

To make sure that indicators are correct to within, say, one per cent the following points must be given careful attention: First, scale of the spring; second, friction of all moving parts; third, backlash of all moving parts; fourth, inertia of all moving parts; fifth, design of pencil motion, and sixth, length and kind of indicator cord.

Good indicator springs when tested by direct loads out of the indicator

usually have correct and uniform scales, that is, they will collapse the proper amount when certain loads are applied. It is true that all springs are somewhat weaker when exposed to high temperatures, but with steam engines the indicator spring is exposed to the steam for short intervals and little or no error is caused by this. Some indicators, like that shown in the illustration, have the spring arranged outside of the cylinder, and with these the steam does not at any time come in contact with it. If an indicator spring is uniform, but is either more or less than the rated scale, a correction may easily be applied. For example, if a spring marked 60 pounds to the inch is found to collapse one inch under 58 pounds, we may use it with accuracy by remembering that the pencil point will be raised one inch for every 58 pounds' pressure. If, however, an indicator spring is irregular, that is, will collapse, say, one inch under 50 pounds and only one and three-quarter inches under 100 pounds, it is absolutely valueless and should in all cases be rejected.

Friction is a necessary evil and the steam indicator is now made so that the amount of this is very small. As indicators are used they will need to be occasionally oiled. In no case should any oil be used except that specified by the makers of the instrument in question. This small matter is one which often brings about errors of from three to five per cent.

Eliminating Backlash

Backlash of the moving parts is another item which must be eliminated as much as possible. The reducing mechanism for conveying the motion of the engine crosshead to the paper drum should be designed as simply as possible. It should then be kept in good condition and any unnecessary looseness corrected: In guarding against friction and backlash the inertia of all moving parts must be considered. The parts are generally light and with care inertia will not cause serious trouble.

The pencil motion is arranged to multiply the motion of the indicator piston about five or six times. This pencil motion must be parallel to that of the piston and is very nearly correct in all first-class instruments. Errors due to the paper drum are proportional to the length of the cord which rotates it. For this reason the length of this cord should be kept as short as possible. Proper cords made for the purpose should always be used to guard against stretch and breakage.

The steam-engine indicator, while by no means a perfect instrument, can easily be used in a manner which will give valuable results. The action of the steam engine can be determined by its use better than by any other way. Engineers may know what their engines are doing by frequent use of the indicator, and the resulting cards may be kept on file for records. The power required by spinning rooms, separate spinning frames, or, in fact, any department throughout the mill may often be advantageously obtained by the use of the engine indicator.

Coal Storage Problems

The problem of providing proper coal storage and efficient apparatus for handling fuel is comparatively simple for a small mill, although even the plants having no more than three or four boilers can almost always save money by putting in some sort of automatic coal handling machinery. The small mill which purchases fuel from local dealers and which has only a limited space for storing coal, due to the fact that this point was not sufficiently considered at the time the mill was built, may find it impractical to make changes for buying coal in large quantities. Even if this is not a practical proposition, it is in most cases safe to assume that some simple type of coal conveyor could be installed at a price which would prove a good investment.

At this time, however, we will confine ourselves more to the consideration of practical methods of storing and handling coal for mills which are so situated that storage bunkers can

be built or at which some type of storage system has been designed without enough attention having been given to the best method of handling the fuel. Probably the most satisfactory and interesting way of approaching this is by giving brief descriptions of a few systems which have been installed in textile mills and which have proved themselves economical and satisfactory.

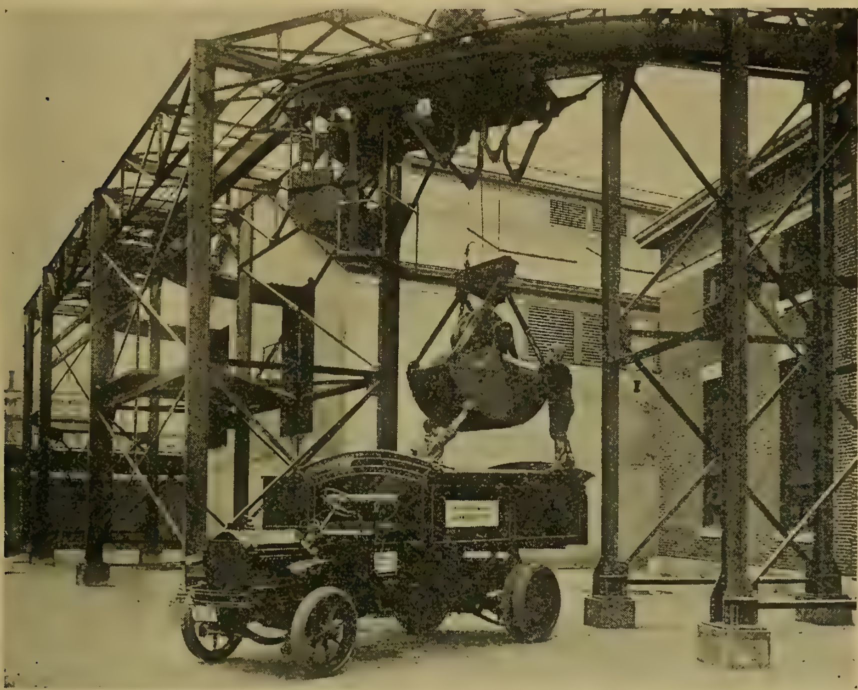

Fig. 180. Coal and Ash Handling Apparatus at the Pacific Mills Power House. The Coal Bunker is Shown at the Left and a Corner of Boiler House at Right. Ashes Are Being Loaded into a Motor Dumping Truck.

Hamilton Mfg. Co.

The boiler house of the Hamilton Mfg. Co., at Lowell, Mass., is arranged so that the coal is dumped from the cars into a concrete pit and is then taken from the pit by an electric hoist and delivered to a crusher which breaks up the large pieces. In connection with this crusher there is a special weighing hopper, and after leaving this the coal is carried by an elevating belt conveyor above the boilers, and is then distributed by another conveyor into several storage bunkers placed over the boilers. From these bunkers, there are chutes equipped with special coal valves, so that as a fireman requires fuel for any particular boiler he draws out a certain amount from one of these chutes and then shovels it from the floor into the furnace. With an arrangement of this kind, coal is drawn directly upon the boiler house floor, but with a fair amount of care the boiler house may be kept clean. When desired, the coal can be taken directly from the railroad car to the crusher without first being dumped into the concrete pit.

At the Wood Worsted Mill, Lawrence, Mass., the coal is conveyed from the storage bunker to the boiler house and distributed before the various boilers by large belt conveyors.

In this particular mill this apparatus was not installed at the start and after it was put in it became possible to handle the same amount of fuel with about one-quarter the help and in about one-half the time.

Pacific Mills

The Pacific Mills, at Lawrence, Mass., built a large power plant about five years ago for furnishing power to what is known as the old print works, the cotton department, the cotton yarn mill, the new worsted mill and a part of the old worsted mill. There was no available land near these mills, and it became necessary to place the station something like half or three-quarters of a mile from the centre of the plant. This was unfortunate on account of the difficulty in utilizing hot water returns from the various departments, but it was a comparatively simple matter to arrange for the transmission of power, as this was to be all distributed electrically.

The Coal Bunker

The boiler house at this station contains 24 boilers and two large brick chimneys. A coal bunker was built of reinforced concrete, having a capacity of 5,000 tons. This main coal storage building has no lower outlet for delivering coal at the bottom of the storage bins, but is designed so that the fuel is taken out by an electric hoist, as required. To provide against the possibility of this electric hoist becoming out of order, a small concrete bin is located at one end of the storage building and has an opening at the side, so that the coal may be removed and taken to the boiler room by the ordinary wheelbarrow or tipcart. This bin, it must be remembered, is provided only for emergency use.

The electric hoist is shown by Figure 180 and is supported by an overhead track as indicated. This track runs between the coal storage bunker and the boiler house, runs in front of both rows of boilers, and also runs

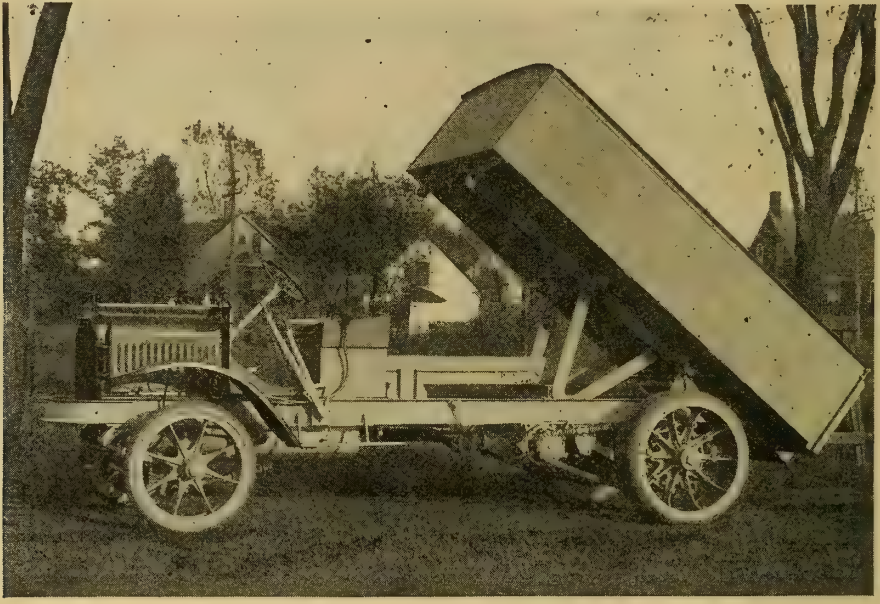

Fig. 181. Motor Dumping Truck Like That Used at the Pacific Mills. Dumping Mechanism is Operated by Power.

over all of the coal storage bins. The clamshell which handles the coal is operated electrically and will pick up approximately one ton of coal at a time. The clamshell and hoisting apparatus is shown over one of the Pacific Mills motor dumping trucks in the yard space between the boiler room and the storage bunker.

The coal cars enter the storage bunker on an elevated trestle and dump either side into the storage bins. The electric hoist runs on the overhead track, takes coal from any desired part of the storage bins, elevates it, carries it to the boiler room and lowers it to the boiler room floor in front of any of the boilers. In this boiler house 12 boilers are placed on each side of the room facing each other, and each set of 12 boilers has a separate chimney. The hoisting car runs over a specially designed scale at the entrance of the boiler house, so that each load that the clamshell delivers is accurately weighed before being dumped on the boiler house floor. To eliminate the necessity of recording the weights of each load with a pencil and paper, a punch arrangement is provided, so that by throwing a small lever the weight is recorded clearly, and the operator has little chance of introducing errors in coal consumption data.

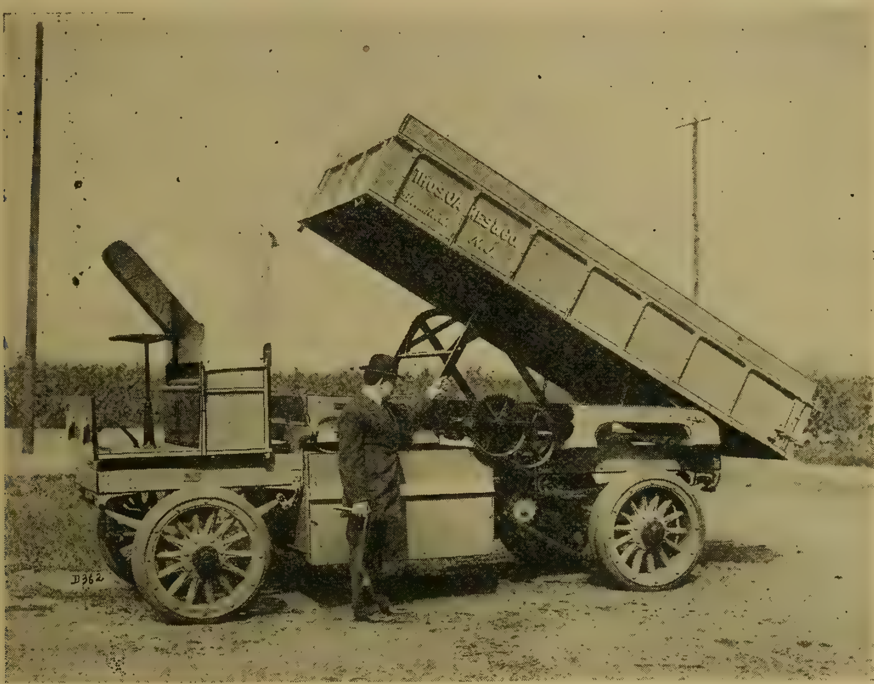

Fig. 182. Motor Dumping Truck
Used by Thomas Oakes & Co., Bloomfield, N. J.

The Electric Hoist

At this plant the ashes are removed by the night men, are wheeled into the yard and can be quickly loaded into teams the next morning with the same clamshell which handles the coal. In connection with the economical handling of ashes, and, in fact, any

Removing Ashes

other materials which must be carried some distance and then dumped quickly, the motor trucks which are to-day used by the most up-to-date mills should receive special attention. Figure 180 shows a five-ton automatic dumping truck made by the White Company which is in use at the Pacific Mills. There are many different styles of dumping trucks suitable for mill requirements and in Figure 182 we show another truck which many of the mills are using and which is manufactured by the General Vehicle Company. This particular truck is used by Thomas Oakes & Co., Bloomfield, N. J.

Figure 181 shows a truck similar to that owned by the Pacific Mills with the body tipped for dumping. To tip this, the driver is not obliged to leave his seat, but operates the dumping mechanism by the same power that drives the truck.

Motor Dumping Trucks

A large new print works and dyehouse is just being completed for the Pacific Mills and is located about two and a half miles from the power station which supplies power to the main mill. There is a separate power house for the print works' plant, but in carrying ashes from the main power house to the new mill for grading purposes the five-ton dumping truck shown in the accompanying illustration has rendered excellent service. Much might be said concerning the increasing uses for all kinds of motor trucks for handling miscellaneous haulage problems which the textile mill must meet.

Fig. 183. Lower Story of Coal Pocket at Pacific Mills New Print Works Coal Cars Similar to That Shown in Figure 186 Are Seen at the Right and Coal Valves for Removing Coal from the Bins Are Seen in the Centre of the Illustration.

This would introduce a discussion dealing with the various types of trucks and will be reserved for a later issue.

The New Print Works

Coming to the installation at the Pacific Mills' new print works, in Lawrence, Mass., we find that the industrial railway type of conveyor is used. As already noted, the facility for storing a large quantity of coal is an essential consideration for mills located some distance from the coal mining territory, and the storage bunker which has just been completed for the power house of the Pacific Mills' print works has a capacity of 10,000 tons and covers about 19½ feet by 153 feet. The footings for this building rest on concrete piles and support six longitudinal rows of 37-inch reinforced concrete columns, placed 16 feet 9 inches on centres. The storage space is divided into several separate bins by concrete walls, so that should the coal in any one of these bins become heated, it is a comparatively simple matter to empty this particular bin without disturbing that which is in the other bins. Figure 183 shows the 37-inch concrete columns and also the type of valve used for drawing out the coal from any one of the several storage chambers. This same illustration shows the narrow gauge railroad for the coal cars, and two cars full of coal are seen at the right. The general method of handling these cars will be described later.

The Storage Bins

Figure 184 shows a view looking down into one of the storage bins, showing the depth and also indicating the way in which the bottom of the bins are shaped so that all coal can be drawn through the valves seen in Figure 183. In Figure 184 a portion of the conveying apparatus and distributing chutes are shown. We will explain their operation in connection with that of the small coal cars. The conveying buckets and chutes just mentioned are illustrated still more clearly by Figure 185. Regular coal cars are brought into the mill yard on a private siding, and the car which is to be unloaded is placed over an opening or hopper which is approximately on the ground level. We should have noted that the car to be unloaded is first weighed on a platform scale, which is located near the above mentioned hopper.

Unloading the Coal

Practically all of the coal which is delivered to this mill is received in the type of car which has a bottom dumping arrangement and the coal is allowed to fall by gravity into the unloading hopper. This hopper, or chute, carries the coal to a crusher which breaks up all large lumps, leaving it in a suitable condition for handling with buckets and for delivering through the coal valves, both of which are shown in the accompanying illustrations. The crusher is in a pit underground, and the first conveying system consists of a bucket elevator. These buckets are really a part of the system of buckets shown by Figure 184, and the other part of the elevator system may be seen at the extreme rear of the room (Figure 185). The buckets in the lower part of this figure are the empty ones returning for a new supply of coal, and the full buckets rise vertically, as seen in Figure 185, and then pass over the chutes which feed the separate bins.

A Ton Per Minute

These buckets are large enough and are designed to move at such a speed that the system can readily take care of 60 tons per hour or one ton per minute. The coal falls from the regular car into the crusher, from the crusher it is delivered to an inclining length of the buckets, which later become vertical and then pass over the entrance to the several chutes. By a simple tripping mechanism, this chain of buckets can be made to empty into

any one of the chutes illustrated, and the chains which are seen in the illustration are for set-

Fig. 184. Interior of Coal Pocket at New Print Works (Pacific Mills) Showing Coal Conveyor and Storage Pits.

ting these respective tripping mechanisms.

At the extreme left of Figure 185 there are still other storage bins which are not equipped with chutes as those shown in our illustration. These are auxiliary or secondary storage bins built so that a large surplus of coal can always be kept on hand

for use in time of any coal shortage or other emergencies.

For filling these bins the buckets are tripped over a large hopper at the end of the building from which coal is fed into an electrically driven metal car. This car after being filled with coal is run out over any one of the auxiliary storage bunkers and is quickly dumped by raising the sides of the car. These car sides are hinged at the top, and the bottom of the car is so shaped that the coal all falls out as soon as the sides are lifted.

The Coal Conveyor

The accompanying illustrations show the mechanism for handling the buckets, this being operated by an electric motor, as indicated. There is nothing complicated to get out of order in this system, and, as already noted, cars can be unloaded at the rate of one ton per minute, and it is possible that even this speed may subsequently be increased.

Coming down stairs upon the same level with the boiler house floor, we reach the room indicated by Figure 183. There are several coal valves for each storage bin, this point being shown by Figure 183 and Figure 184. The coal cars from which the fuel is shoveled directly into the boilers are shown in Figure 183. Each of these cars holds about one ton of coal and is handled easily, on the narrow gauge track, by one man. Switches are arranged so that the car can be filled from any one of the numerous valves, and then the cars are pushed by hand to the boiler house.

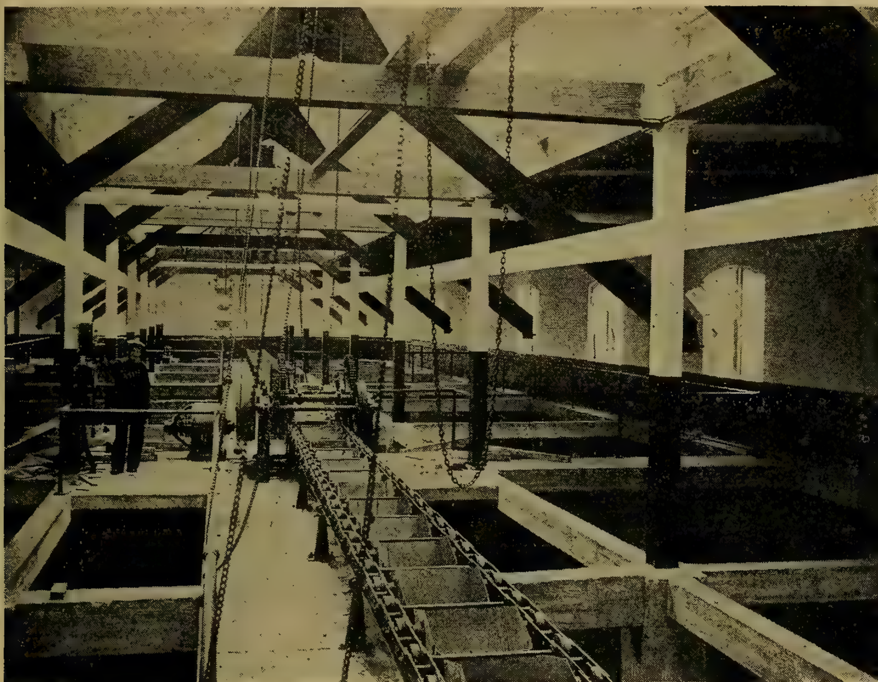

Fig. 185. Upper Story of New Print Works (Pacific Mills) Showing Coal Conveyor.

There are 30 Bigelow boilers in this station, 15 being placed on each side

of the room and having two separate stacks. The tracks for the industrial coal cars are arranged so that the car can be weighed at the entrance to the boiler room and then moved in front of any one of the boilers, being the proper distance away from them to enable the firemen to shovel directly from the steel car. One of these cars is shown by Figure 186 with the side lowered into a horizontal position ready for feeding one of the boilers filled from the valves at the bottom of the bunkers in less than a minute. The entire outfit for handling this vast quantity of coal, including the equipment for filling the auxiliary storage bins, takes up little room, is easy to keep in repair and is a decidedly practical arrangement.

Small Steel Cars

The general construction of the building itself is of unusual interest

Fig. 186. Steel Coal Car Used for Bringing Fuel from Storage Bunkers to Boilers.

in a plant equipped with apparatus similar to that used at the Pacific Mills' print works.

From the time the coal is unloaded until it is shoveled into the furnace, it is all handled by a combination of automatic dumping buckets and small steel cars. The fact that the coal is shoveled directly from the car, as shown by the accompanying illustration, keeps all coal off from the boiler house floor and adds a great deal to the general cleanliness of the room. The coal is brought into the storage bunkers at the rate of one ton per minute and the one-ton cars, similar to that shown by Figure 186, can be especially due to the fact that a good deal of the concrete was laid during the cold weather. The concrete construction company which did this work and the mill architects who superintended the construction have had considerable experience in handling concrete under adverse weather conditions and showed plainly what they could accomplish in this particular construction.

Concrete Construction

The water used for mixing the concrete was heated by means of a steam jet placed in the water barrel. Steam was also applied directly to the sand

pile and to the stone pile, and before the concrete was poured steam was applied to the forms for removing all snow and ice. Large sections were covered with canvas, and salamanders using coke were placed beneath all freshly poured concrete and kept burning until it had thoroughly hardened.

Special Ash Cars

There is a sub-basement underneath the boilers, and the ashes are removed through valves somewhat similar to the coal valves shown in our illustrations. The small steel car for handling the ashes has a specially designed top and cover which fits onto the ash valve closely, so that the car is filled without allowing any dirt and dust to escape into the air. At the present time, the Pacific Mills is using the ashes for grading purposes and the special ash car is moved directly to the dump and emptied by lifting the sides. The track on which these cars run is light and can be quickly laid to new locations, as it may become necessary to take the ashes to different parts of the yard, or to any type of elevating apparatus for filling carts or cars.

Space Required

When considering the erection of a new mill it is often a help to have on hand figures by which the approximate size required may be ascertained. To a considerable extent this depends upon many special conditions, but the figures about to be given will in many cases be found useful. Cotton machinery has been manufactured for many years, and, although at the present time new inventions are being introduced almost daily, these are largely of a character that do not alter the amount of floor area required by the various kinds of machinery. We find that cotton machinery manufactured by different concerns does not vary much in its overall dimensions, so that the actual space needed for placing machinery may be closely approximated even previous to the placing of any orders for same.

Arranging Machinery

The spacing required between the various kinds of textile machinery is a subject which has received much attention. Mill men today do not always agree upon the width required for aisles, passageways, storage space, etc., and in all probability they never will. In some instances the main object worked for is to get all the machinery possible into a certain space, and in doing this working spaces are made as small as the width of bobbin carts and other trucks will allow. Some go to the other extreme and insist upon a spacing of machinery which not only wastes room but also much of the operator's time. If the product from the cards, for example, has to be carried a long distance to the drawing frames a small amount of time is lost very often, and at the end of even one week it amounts to an item worthy of consideration. In preparing a set of figures indicating the amount of floor space required per machine or per spindle by a cotton mill data has been taken where machinery was somewhat crowded, where spaces considerably too large have been left, and also, where, in the opinion of the writer, the best possible relations between machinery space and alley space exists. This data has been carefully compared and averages obtained, after first, however, throwing out cases which seemed extremely undesirable. In building a new mill the additional future machinery should always be considered, but this extra room should be figured at the start to as great an extent as is possible.

Picking Machinery

Starting with the picker rooms we find that out of twelve mills considered the average floor space provided per machine was 450 square feet. The largest amount provided was 500 square feet and the smallest slightly

under 400 square feet. Some of the rooms were equipped with two heater breakers which are larger than the single heaters now coming into more frequent use. Results will, however, be fairly close by use of the average value, 450. Coming to the carding department the average space provided per card was found to be 123 square feet. The total number of cards installed in the combined rooms of the mills considered was 350, and the space provided per card varied from 100 to 160 square feet.

Speeder Rooms

Drawing frames are frequently placed much too close together, and, although the result obtained from investigations made in twelve mills gives an average space per delivery of about 20 square feet, the writer would advise the use of 25. The important point sometimes overlooked is the fact that the coiler cans are seldom placed in such a way as to use the minimum amount of space. Any excess room around the slubbers is never wasted and if the drawing frames take less room than that allowed it is easy to arrange this to come near the slubbers. Although more room is desired around slubbing frames than around intermediates and roving we will consider them all under the name of speeders. For these the floor space per spindle figures slightly over two square feet, and the value, 2.3, is a safe one to use.

Spinning Rooms

In considering the amount of room to allow for ring spinning frames we will divide them into three groups according to the gauge used. For 2¾-inch gauge 0.9 square feet per spindle should be provided; for 3-inch gauge this figure increases to 0.95 square feet per spindle and with 3¼-inch gauge one square foot per spindle is none too much. The space taken up by mule spinning also varies with the gauge, but from data taken from three mills the value of about one and three-quarters square feet per spindle was obtained. Twisters require from one to two square feet per spindle according to the gauge, while about two and one-half should be figured for spoolers, and one and eight-tenths for reels. Looms should be given from forty to sixty square feet per machine, and an average taken from five mills having together about twenty-five hundred looms gives us fifty-four and one-half.

The following table is given showing the various values just described, and, while it may be wise to diverge from them greatly in some cases, they can often be used to advantage in making preliminary investigations concerning the size and type of mill best suited for cases in question.

Machine.	Sq. ft. per inch.	Sq. ft. per spindle.
Picking machinery	450	...
Cards	123	...
Drawing frames	...	*25
Speeders	...	2.3
Ring spinning, 2¾ in. G..	...	0.9
Ring spinning, 3 in. G....	...	0.95
Ring spinning, 3¼ in. G..	...	1.00
Mule spinning	...	1.75
Twisters, 3 in. G.........	...	1.1
Twisters, 3¼ in. G......	...	1.2
Twisters, 3½ in. G......	...	1.3
Twisters, 3¾ in. G......	...	1.4
Twisters, 4¾ in. G......	...	1.8
Spoolers	...	2.5
Reels	...	1.8
Looms	54.5	...

*Per delivery.

Types of Mill Construction

After deciding upon the approximate amount of floor area required to furnish a certain desired output the question immediately arises concerning the type of construction, the number of stories and the cost. The standard type of slow burning mill construction is the type most often used for textile purposes, although reinforced concrete is becoming more and more popular for all classes of building construction. The conditions governing the type of construction are cost, safety, durability, time of erection and fire protection, while many minor factors enter into each individual case. Types of buildings for mills may be classified as follows: (1) frame construction; (2) steel construction; (3) mill or slow burning construction, and (4) reinforced con-

crete construction. The first type is the cheapest at the outset, but its great fire risk and lack of durability make it very undesirable for textile use.

Types of Construction Compared

The second or steel construction makes a very desirable building, and the amount of steel used in textile buildings has greatly increased during the last few years. Steel beams are used with wooden floors and also with floors of concrete. In the first case the fire hazard is greater than with the floor of concrete, but this hazard is much less than that with a frame or slow burning mill type construction, and the durability is at the same time greatly increased.

The mill or slow burning type of construction, as its name implies, is not fireproof, but the use of large heavy beams and planks instead of large quantities of lighter stock makes danger from fire very small in comparison with that where light wooden frame work is used. As already stated, this slow burning mill construction is to-day by far the most common type used by the textile industries.

Reinforced Concrete

Coming lastly to reinforced concrete construction for textile mills we arrive at a style of construction comparatively new. It is very desirable from the standpoint of fire risks and due to this characteristic enables the owners to obtain insurance at better rates. It is proving itself to be exceedingly durable, thus eliminating frequent repairs and renewals, and in some cases has been erected more quickly than the standard type with brick or stone walls. Its cost depends greatly upon local conditions. Some instances have been known where gravel, from which the concrete is made, has been taken from the excavations made necessary by the new building itself, and in such cases mills have been built for about the same cost as would have been necessary had the slow burning type of construction been followed. It is generally, however, somewhat more expensive. Concrete construction for the textile mill has often been objected to on the ground that much more trouble and expense was necessary in suitably fastening machinery and shafting. This is being overcome in many different ways by the incorporation of wooden stringers within the concrete floors, to which are fastened in some cases a complete top flooring of wooden plank. It is impossible to know the extent to which reinforced concrete will replace the brick or stone mills for new plants, but there are many reasons for believing that this will be true to a considerable extent within the next ten or fifteen years.

Cost of Construction

Although we have gone at some length into the subject of reinforced concrete for textile mills, let us return once more to the slow burning type of mill. These consist of stone or brick walls having heavy wooden beams for supporting the flooring and roof. In speaking of the cost of these mills we will consider those having brick walls and not those having stone. While contractor's bids may readily and quickly be obtained after building plans are made a rough estimate of the cost at the very outset often proves that a height or width very different from that contemplated is the one most economical. In speaking of mill widths it seems wise to note that cotton mill rooms, in which drawing frames are to be placed, should have this fact carefully considered, for often a poor machinery arrangement is made necessary by the inability to properly locate the drawing frames. Prices are constantly changing in every line, and the cost of mill construction is much different than it was ten years ago. In the figures about to be given the prevailing prices during January, 1910, have been averaged and used.

Foundations

Let us first consider mill foundations. The cost of this work depends greatly upon the kind of soil, and the presence of any unusual mud or other soft and undesirable bottom must be given special attention. For ordinary straightforward work, however, the following figures, which include excavation, may be used to advantage. The prices given are the cost per linear foot for foundations under outside walls and inside walls:

OUTSIDE WALLS.

One story	2.00
Two stories	2.90
Three stories	3.80
Four stories	4.70
Five stories	5.60
Six stories	6.50

INSIDE WALLS.

One story	1.75
Two stories	2.25
Three stories	2.80
Four stories	3.40
Five stories	3.90
Six stories	4.50

Walls

For determining a rough estimate of the cost of brick walls, including doors and windows, the brickwork is based on twenty-two bricks per cubic foot, costing $18 per thousand laid, and openings are estimated at 40 cents per square foot, including windows, doors and sills. Cost per square foot of brick walls, including doors and windows:

OUTSIDE WALLS.

One story	40 cents
Two stories	44 cents
Three stories	47 cents
Four stories	50 cents
Five stories	53 cents
Six stories	57 cents

INSIDE WALLS.

One story	40 cents
Two stories	40 cents
Three stories	40 cents
Four stories	43 cents
Five stories	45 cents
Six stories	47 cents

Floors used in slow burning mill construction will cost about thirty-two cents per square foot and by adding five cents per square foot we may include columns, column piers, castings and wrought iron work used with same. Standard tar and gravel roofs may be figured at thirty cents per square foot, which price includes columns and an overhang of about eighteen inches.

Two stairways should be allowed in buildings 300 feet long or under, and these stairways for buildings over 300 feet in length. They will cost about $100 per flight per story.

Correct Records

With electrical apparatus, it is easy to keep correct data concerning the amount and cost of power used by the various departments of a textile mill. Some mills, where it would be simple and economical to keep correct records of the power used, do have a certain method of recording the horse power consumed, the daily coal consumption and various other records, but the manner in which data for some of these records is obtained makes it worse than useless. Unless the data as taken is correct, it is absurd to make lengthy calculations from it.

In many instances, mill men do not install recording electrical instruments, and, in fact, some concerns using alternating current are not equipped with any type of wattmeter. A representative of the American Wool and Cotton Reporter recently asked a master mechanic of a good-sized textile mill how they kept track of the amount of alternating current used for power purposes. A blank was shown on which four readings in kilowatts were marked daily. There was no wattmeter to be seen on the switchboard, and the question naturally arises as to how the readings were obtained. It was found that four readings were taken daily of the volts and amperes, and that these were multiplied together and entered upon the report as watts in the same manner as would have been correct for a direct current. Every master mechanic who has anything to do with electrical apparatus should certainly know that the product of volts and amperes does not give the correct number of watts for an alternating current. To obtain the watts from this product, a certain power factor must be used which varies according to the nature of the

load. The mill in question receives a good amount of power from the alternating current generator. There can be no good reason why this plant did not have at least an indicating wattmeter.

It is not our intention to dwell upon the different kinds of electrical meters, but we do wish to point out the advantage of keeping some kind of an accurate record for all departments of the power house, and an accurate record cannot be obtained without the use of proper measuring devices.

The Power Plant

Not many years ago, the steam engine indicator was understood by comparatively few operating engineers. To-day it is used in probably all engine rooms of consequence. Many engineers to-day do not get the value from their indication diagram which they should. Nearly all of them, however, are obtaining some help from the use of this appliance, while there are many other simple devices which they do not use at all.

The power records may be valuable, so that they must be recorded in some systematic way, and the matter must be in charge of a capable and responsible party. There should be some person in each mill who can obtain from his file an accurate record of the efficiency under which his power plant is

Fig. 91.

DAILY BOILER HOUSE REPORT

THE AMERICAN THREAD COMPANY.

KERR MILLS, FALL RIVER, MASS.

No. 1 & 2 PLANTS. *DATE,* ________ *191*

COAL AND ASH.

CAR NO. & INITIAL	KIND	QUALITY	POUNDS

	ANT.	BIT
Bal. on Hand—Tons.		
Coal Unloaded—Lbs.		
" Cons'd—No. 1 Plant—Lbs.		
" " — " 2 " — "		
" " —Caustic Pl't—Lbs.		
Total Consumption "		
Coal Put in Storage "		
Bal. on Hand—Tons.		
Ashes—No. 2 Plant—Lbs.		

LABOR

	NO. 1 PLANT. DAY	NO. 1 PLANT. NIGHT	NO. 2 PLANT. DAY	NO. 2 PLANT. NIGHT
No. Foremen				
" Firemen				
" Ash Wheelers				
" Coal Trimmers				
" Unloading Coal				
" Telpermen				

WATER.

	No 1 10 A. M.	No 1 3 P. M.	No. 2 10 A. M.	No. 2 3 P. M.
Temp.—Heater —0° F				
" —Pump — "				
" —Econ. No. 1— "				
" — " " 2— "				

METERED NO 2 PLANT

12 Night—6 A. M.—Lbs	
6 A. M.—12 M— "	
12 M.—6 P. M.— "	
6 P. M.—12 Night "	
TOTAL	
Deduct for Blowoff, Etc., Lbs	
Lbs. Water Evap'd. Act. No. 2 Plant	

Temp Flue Gas Ent. Econ.—No. 1 No. 2 Plant		°F
" " " Leav " " " "		°F
" " " Ent Econ.—No. 2 No. 2 Plant		°F
" " " Leav. " " " "		°F
Av. Thickness of Fire " "		In.
" Boiler Pressure " "		Lbs.
" Steam Temp. " "		°F
" CO_2 —Boiler No. " "		%
" Temp. Boiler Room " "		°F
Weather		

Boilers in Use.

Boilers No.	1	2	3	4	5	6	7	8	9	10	11	12
No. 1 Plant												
No. 2 Plant												

being operated. Some record should be on hand giving the amount of feed water used, temperature at which this feed water is introduced into the boilers, the temperature of this water on entering and leaving the heaters, the amount of coal burned per horse power developed, the temperature of the flue gas each side of the economizer, the amount of carbon dioxide in the flue gas, and many other equally important points, the number of which varies with the size and kind of equipment.

Some Examples

Figure 91 is a reproduction of the daily boiler house report used by the Kerr Mills of the American Thread Company. Figure 92 is a corresponding daily report of the power house.

Fig. 92.

DAILY POWER HOUSE REPORT

THE AMERICAN THREAD COMPANY.

KERR MILLS, FALL RIVER, MASS.

No. 2 Plant. Date, ________ 191

TURBO—GENERATORS															STEAM	
TIME	VOLTS			AMPERES			K. W.			POWER FACTOR	FIELD AMPERES				PRESS.	TEMP
	1	2	3	1	2	3	1	2	3		1	2	3			
10 A.M																
3 P. M.																

EXCITERS									
TIME	VOLTS			AMPERES			K. W.		
	1	2	3	1	2	3	1	2	3
10 A.M.									
3 P.M.									

OPERATION—HRS. RUN					
TURBO—GEN.			EXCITERS		
1	2	3	1	2	3

TIME	10 A. M.	3 P. M.
Temp. Turbine Room		
" Outside Air		

CONDENSERS								
TIME	INLET	OUTLET			VACUUM			BAROMETER
		1	2	3	1	2	3	
10 A.M.								
3 P M								

SUPPLIES

DISTRIBUTION OF POWER

MILL NO. 1 K. W		
SWITCH	HOURS RUN	LOAD
LIGHTS		
1ST FLOOR CARDING		
2ND FLOOR CARDING		
3RD & 4TH FLOOR MULE SPINNING		
5TH FLOOR, N. RING SPINNING		
5TH FLOOR, S. RING SPINNING		
TOTAL		

MILL NO 2 K W		
SWITCH	HOURS RUN	LOAD
LIGHTS		
NO 2 MILL CASSING & PICKER ROOM		
TOTAL		

ENG'R & ASS'TS—

OILERS—

REPAIRMEN—

REPAIRS:—

MILL NO 3—K W HRS			
SWITCH	HOURS RUN	READING	K W HRS
LIGHTS			
BASEMENT			
1ST FLOOR I D TWISTING			
1ST FLOOR TWISTING			
2ND FLOOR COP WINDING			
3RD FLOOR CARD & PICKER			
4TH FLOOR CARDING			
5TH FLOOR, N. RING SPINNING			
5TH FLOOR, S. RING SPINNING			
TOTAL			

For many plants, temperature readings, pressure readings, electrical readings, etc., may be taken from two to four times each day, and the average of these observations used. It is, however, often advisable to install some kind of recording apparatus by which a complete record is obtained for each day's run. Figures 89 and 90 in the June 15 issue of the American Wool and Cotton Reporter are reproductions of two actual charts, showing respectively tem-

perature of the feed water as it leaves the heater, and the economizer. These charts are changed daily, and from them the exact reading corresponding

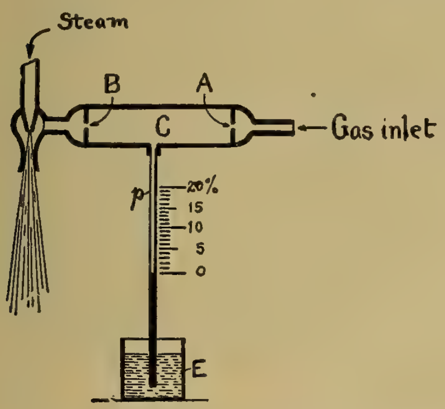

Fig. 94. Diagram Illustrating Operation of Machine for Measuring Carbon Dioxide Gas.

to each hour of the day is known. A recording instrument can be used for indicating the amount of feed water used throughout the day, and recording electrical instruments are upon the market which indicate the electrical power delivered.

Figure 88 in the June 15 issue of American Wool and Cotton Reporter is a reproduction of a chart made by the American Thread Company's plant, which shows the percentage of carbon dioxide in the flue gas.

Engine Room Data

Figure 92 is a convenient form for recording engine room data. The American Thread Company generates its power by steam turbines directly connected to electrical generators, so that the items appearing in Figure 92 refer to the electrical readings, temperature readings and the distribution of power. For a power house using reciprocating engines, certain changes to this form would, of course, be necessary.

Several Copies

Reports similar to those illustrated by Figures 91 and 92 should be made out upon manifold pads. The number of copies needed is governed entirely by the size of the plant. A copy of all such records should go to the engineering department where they should be examined at once, checked over carefully, and kept on file. As a rule, the treasurer or agent should receive a condensed summary of these reports, and this summary should be made out by the engineering department. Of necessity, the above summary will be somewhat delayed in reaching the agent or treasurer, and one of the manifold copies of the original report should go at once to their office. It is probable that this original

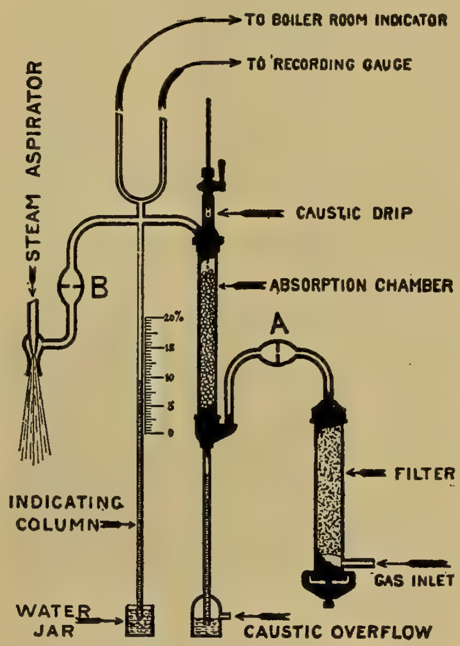

Fig. 95. Diagram of Most Important Parts of Carbon Dioxide Instrument

report will seldom receive much attention from the agent if the summaries are sent to him promptly and regularly. In looking over the condensed summary, some item may appear unusually large or small, and the agent or treasurer may wish to follow this figure daily for a short time. This is one reason why he should receive a copy of the original report.

Reduces Expenses

It will be noted that the form illustrated by Figure 91 shows at a glance the kind and quantity of coal on hand; the car numbers are noted, and a summary made from this part of the report should be sent to the purchasing department at regular intervals. There is a weekly report which contains many items of value to the purchasing department. It likewise furnishes data for the cost keeping department as well as giving the engineering department figures which show whether or not the plant is being operated efficiently, and if not, where the abnormal expenditures lie.

The master mechanic of a medium sized and even fairly small mill should have records similar to the ones illustrated, kept accurately. There is no call for their forms being nearly as long and detailed as the ones shown, but a dozen or so of the most important figures should always be kept on file.

We find that it is customary for most mills to keep records of this sort, but we also find that there is a tendency for these to be inaccurate. or, if accurate, they are often given too little attention. It cannot be expected that the treasurer of a mill will keep close watch of these details from day to day, but he should employ competent men in the power department who realize the advantages to be gained by keeping careful watch upon the costs of producing light, heat and power.

The Fires

Much waste can be prevented by giving careful attention to the fires under the boilers. If too much air is fed to the fires they will be unnecessarily cooled and heat will be wasted. If, on the other hand, too little air is supplied, the combustion will be incomplete and carbon monoxide gas will be formed. Every pound of carbon which is burned to carbon monoxide instead of carbon dioxide signifies a loss of many thousand British thermal units. Good results can generally be obtained by supplying about 40 per cent excess air. This amount of air corresponds with a certain percentage of carbon dioxide in the flue gas. By keeping an accurate record of the amount of carbon dioxide it is possible to determine the quantity of excess air which is being supplied.

Carbon Dioxide

Figures 94 and 95 illustrate the method of operation of a carbon dioxide meter. Instruments of this type are in use in many textile mills. In testing samples of flue gas with an Orsat apparatus, or by any ordinary carbon dioxide recorder, the amount of carbon dioxide is determined by passing the gas through a solution of caustic potash which removes the carbon dioxide from the sample. The volume of gas is measured before and after it has been passed through the caustic potash solution, and the decrease in volume represents the amount of carbon dioxide which was previously present.

Apparatus designed for taking samples of flue gas and analyzing them is comparatively simple, but is, nevertheless, a rather delicate apparatus to use every day for frequent readings.

The automatic instrument, whose operation we will explain by the use

of Figures 94 and 95, makes use of the same fact, that the carbon dioxide is absorbed by a solution of caustic potash

Automatic Instrument

With the automatic measuring device, the flue gas to be analyzed is drawn through two apertures A and B, Figure 94, by a constant suction produced by an aspirator, shown in the ilustration. If these two apertures are kept at the same temperature, the suction, or partial vacuum in the chamber between the two apertures, will remain constant so long as all the gas passes through both apertures. If part of the gas is taken away or absorbed in the space between A and B, the vacuum will increase in proportion to the amount of gas absorbed. By connecting a water column or light vacuum gauge with the chamber C, the amount of gas absorbed will be indicated by the vacuum reading. Figure 95 is another diagram of the same apparatus as that shown in Figure 94. It is, however, more complete and illustrates more clearly some of the details of the apparatus. The instrument consists of a filter absorption chamber, two apertures, A and B, and small steam aspirator. Gas is drawn from the uptake of the boiler by means of the aspirator through a preliminary filter located at the boiler, and passes through a second filter on the instrument as shown. Besides these filters, auxiliary filters are placed before each aperture in order to prevent any possibility of these openings becoming clogged.

The clean gas passes through aperture A, then through the absorption chamber and aperture B to the aspirator, where it leaves the instrument with the exhaust steam. A diluted solution of caustic soda flows into the absorption chamber by gravity. This flows through a sight feed which is regulated by a cock as indicated in the illustration. The carbon dioxide is completely absorbed by the caustic solution as the gas flows through the absorption chamber and while it is between the apertures A and B. This reduces the volume and causes a change in the partial vacuum of the gas between the two openings. This vacuum varies in accordance with the percentage of carbon dioxide contained in the gas, and is indicated by a water column shown in Figure 95.

Recording Meter

Other indicating columns may be placed at any desired part of the power house. Figure 95 shows the manner of connecting two other indicators. One is shown going to the boiler room indicator and the other to the recording gauge, which gives the printed chart like that illustrated in Figure 88 in the American Wool and Cotton Reporter for June 15. With an instrument of this kind, the indication of the percentage of carbon dioxide is continuous, that is, the gas is always being drawn through the apparatus.

The question of proper draft for textile mill power plants is one which opens up the subject of chimney requirements. Where any of the various forms of mechanical draft are used, the matter of the proper height for the chimney becomes of less importance, but where "natural draft" is depended upon, the chimney should be designed in accordance with the work it is to do.

Chimney Design

Much has been written upon the theory of the draft within chimneys, and while theory adds materially in chimney design, it is best in all instances to take advantage of practical results obtained with chimneys in actual use. Rules and formulas have been worked out, some of which give fairly good results, but it is a simple matter to compare new requirements with some plant already in operation.

Two factors affect the capacity of a chimney, its cross-sectional area and

Chimney Capacity

its height. An engineer once said that high chimneys "are monuments to the folly of their builders." This statement is frequently quoted, and while it is in a way true enough, it must be remembered that too low chimneys are extremely undesirable. The fact that too high chimneys are not wise investments should in no way discourage the erection of chimneys 150 to 200 feet high, according to local conditions. Cheap, low-grade fuels require more draft than some of the more expensive kinds, and it may prove more economical to build a fairly high chimney that the cheaper grade of coal can be used with satisfaction. At times of abnormal demands for steam, it is often of great value to have ample draft, as this serves as reserve boiler capacity, and is as good as additional boiler-heating surface.

Square Versus Round

Some of the old textile mills have square chimneys, and it is not advisable to pull these down that others may be built. Square chimneys do not, however, give as good results as those of round section, and the latter type are considerably less exposed to the wind pressure. The octagonal shape offers but little more exposure to the wind, but as a rule, it is best to build round chimneys. A round flue offers less resistance to the gases than a square one, the corners of the latter being always filled with eddy currents which are not effective for carrying away the products of combustion.

Steel Stacks

Steel chimneys have been introduced considerably, and for some plants, they prove a wise investment. This is the case principally with the smaller power houses, although there are many engineers who advise the steel stack with our large modern stations. Steel stacks are sometimes lined part way with brick, and in other installations they consist simply of the sheets of steel rolled and riveted together. The durability of a steel-plate chimney depends upon the thickness of the metal, the kind of fuel burned in the furnaces, the atmospheric conditions surrounding the location, and the care taken to maintain the chimney in good condition. Steel stacks should always be kept well painted, and this expense is sometimes pointed out as offsetting the interest charge on the higher cost of a brick chimney.

Several guy wires are used to support steel stacks against all wind pressure, and they can generally be fastened conveniently in the wall, or upon the roof of some nearby building. Frequently, these guy wires will have little work to do, as the weight of the chimney itself gives considerable stability. They should be firmly fastened, however, and should always be larger than the actual resistance to breakage would demand. The reason for this is that the wires are exposed to the weather, and are apt to become considerably weakened with use. To be sure, it is possible to watch these stays and to have them renewed when necessary, but this may be forgotten, and it is better to supply good, large wires at the outset. It seems hardly necessary to call special attention to this detail, but there are contractors who ordinarily do the best of work that seem to use little judgment when dealing with the question of wind pressure against steel stacks. For stacks 50 feet high or more, it is seldom wise to use wire rope smaller than one-half inch.

Round Brick Chimney

The ordinary round brick chimney has an outside wall of carefully selected hard brick, with an inside wall, which forms the flue or core. The core is so arranged that it may expand and contract with the changes of temperature without in any way straining the outside wall. The inside wall is built to support its own weight only as the external brickwork protects it from all outside stresses. The top of a brick

chimney is generally arranged so as to shed rain, and keep the water from penetrating the brickwork, but the shape of the top is mainly a matter of appearance.

Concrete

Chimneys of reinforced concrete are and can frequently be built considerbeing used with the best of results, ably cheaper than those of brick. This type of chimney is comparatively new, but the fact that one single firm in the city of Chicago has erected nearly 1,000 of them in seven years, indicates that this is to be one more important use for cement.

Whatever type of chimney is used, the foundation should be carefully laid. If the chimney is a large one the services of an engineer familiar with this kind of work should be employed. The weight of a chimney is concentrated at the foundation on a small area and the disastrous results that would follow defective workmanship make safe work necessary.

Foundations

A natural foundation is to be preferred, but piling and other artificial methods of preparing the earth for the foundation may be used when necessary. Good, natural earth should carry, with absolute safety, from 2,000 to 4,000 pounds per square foot, and the base of a chimney should be spread out so that this pressure, or whatever the earth can safely bear, may not be exceeded.

It must be remembered that the work required of one chimney may be very different from that demanded by another set of boilers used for furnishing the same amount of power. This does not make it impossible to use data obtained from one plant in determining the best design for another, but necessitates a consideration of many details when making comparisons. What we speak of as draft is really a pulling force. This force must be sufficient to overcome friction through the grates, and this varies according to local conditions.

Various Local Conditions

The friction through the coal depends upon the depth of the fires, the quality and grade of the coal, the tendency of the fuel to clinker, and the manner in which the fireman operates the plant. Different kinds of boilers have their special methods of baffling the hot gases, and the friction thus introduced varies considerably according to the type of boilers in use. The attention of the writer was recently called to a certain boiler plant where much trouble was being encountered with poor draft. The man in charge of the station had informed his employer that it would be necessary to install some form of mechanical draft in order to generate the steam needed. The draft was poor, but nearly all the trouble was corrected by changing the arrangement by which the boilers were connected to the chimney. The flues were many times too small and were turned through sharp and unnecessary bends on their way to the main stack.

Reducing Boiler Expense

Good, strong vigorous draft makes it possible to furnish steam with a smaller number of boilers than are otherwise needed, thus reducing the initial equipment expense. Operating expenses are also decreased by using fewer boilers, each loaded near its rating. Along this line the following interesting statements were made by Mr. Henry G. Brinckerhoff in a paper recently read before the National Association of Cotton Manufacturers: "It is becoming generally appreciated that there is also considerable economy in running with fewer boilers, due more or less to the following causes:

"First. There is less expense for banking same at night, as it costs no more to bank at night a highly developed boiler than for one running under or at normal rating.

"Second. With an intensity of fire the gases are more completely burned to carbon dioxide. A low flue temperature does not indicate that the gases were completely burned, and, in

fact, it generally shows that they were not, as well as having an excess of air

"Third. The better circulation set up and the more rapid circulation of steam makes better boiler efficiency. I remember, in my reading of an interesting account of a discussion on that matter, that experiments had absolutely proved that there was a better transference of heat to ebullating water than to still water, and abroad they have carried this out logically in firing special boilers to heat the water for the steam making boilers.

"Fourth. Although, aside from any use of the economizer, there is generally a greater gain to be had from an intensive furnace, it is very apparent that the economizer value is increased greatly by bringing the heat in the flue down the lowest point allowable to sustain draft."

Lightning Protection

A cast iron cap is generally fitted into the top of a brick chimney, and if the stack be a high one, it is usual to install a system of copper rods to conduct lightning discharges down to the ground. The Dwight Manufacturing Company, of Chicopee, Mass., have recently erected a brick chimney 250 feet high, designed by Charles T. Main, for handling about 7,000-horse power. This chimney is equipped with a system of lightning protection which we will briefly outline.

The outside of the chimney is octagonal in section for something over 40 feet in height. At this part it is 26 feet from face to face, and the diameter of the flue itself is 12 feet throughout its entire 250 feet. There is a stone water table set in the outside wall at the top of the octagonal section, and above this point the chimney is round. The diameter decreases gradually to about 16 feet at a point 33½ feet from the top, and then flares out to form the top.

To collect and convey to earth any lightning discharge there are 10 three-quarter-inch copper rods screwed securely into two cast iron caps which are set into the brickwork of the inner and outer walls respectively. Four copper ribbons, one-eighth of an inch by one inch, connect the two cast iron caps with the ground. The two caps are electrically connected, a 2-inch expansion loop being provided to take care of the changes in length of the inner wall or core. The four copper ribbons are spaced equally around the chimney and are fastened by copper clamps held by insulating blocks set into the brickwork. The ribbon conductors are arranged to slide up and down behind the copper clamps and a 2-inch expansion loop is provided every 100 feet. Every 36 feet copper bands, two inches wide, encircle the chimney, and they are all electrically connected to the vertical conducting ribbons.

Ground Connections

At the base three of the copper ribbons are buried about 20 feet in the ground, the end of each being securely riveted and soldered to a copper plate 2½ feet by 5 feet, which is buried in a 2-foot layer of charcoal or crushed coke. The fourth conductor is led to a water main and soldered in two places to brass plugs screwed into separate lengths of pipe.

Mechanical Draft

We have already stated that with mechanical draft the height of the chimney becomes less important. Mechanical draft can be used to advantage in many power plants originally arranged for natural draft only. For new power stations it is impossible to state definite rules along this line, as it is sometimes much better to build a sufficiently high chimney to obtain ample natural draft, while in other instances a modern application of artificial draft is doubtless the best method.

Mechanical draft may be either of two systems or a combination of them both. The systems are known as induced draft and forced draft, while the combination of them both is called balanced draft. With induced draft a

fan is arranged to suck the gases through the furnaces and discharge them into the air through a chimney, which is, as a rule, short. Old plants making use of the induced draft often have fairly high chimneys and these work equally well. Forced draft is the name given that system where air is forced into the furnace beneath the gratebars, either by a fan or by a jet of steam.

Advantages

Some of the advantages gained by the use of mechanical draft can be summarized as follows: First. By regulating the speed of the fans, or the amount of steam fed to the jet blower, it is possible to change the draft to suit the demand for steam, regardless of weather conditions. It is customary, as has been previously indicated in the American Wool and Cotton Reporter, to arrange automatic controlling devices in connection with the damper regulators by which the amount of draft is changed as the boiler steam pressure varies.

Second. Mechanical methods make it possible to create much stronger drafts than can be obtained by chimneys of practical height.

Third. Economizers placed in the flue may utilize more of the heat from the gases than with natural draft, for the amount of draft does not depend upon the temperature that the gas is delivered to the chimney.

Fourth. Cheap and low-grade fuels can be burned with mechanical draft, which could not be used without strong drafts.

Fifth. The erection of high chimneys cost considerable, and should the textile mill wish for any reason to change the location of its power house, the chimney cannot be moved. Apparatus for furnishing mechanical draft can, on the other hand, be readily removed to the new location.

The Steam Jet

Several different arrangements are upon the market for forcing the fire under a boiler by means of a steam jet. These may be easily applied to old boilers where the draft is poor but they use considerable quantities of steam and cannot be advised for new installations. By blowing a jet of steam through a specially shaped air nozzle, large amounts of air are sucked in with the steam and the mixture blown through the fire. With some kinds of low-grade anthracite coal the mixture of air and steam tends to soften the clinkers and thus aids combustion. However, unless it is possible to obtain a device of this sort, more eocnomical in the use of steam than those commonly found at the present time, they should not be depended upon for general use.

Fan Design

The proper design of fans for various purposes is a study in itself, and frequently, when trouble appears with systems of mechanical draft, it is removed by the installation of proper fans. A well-known firm, who has given this question careful study for years, makes the following statements:

"In the design of a (fan) wheel to meet given requirements it is necessary to make its peripheral speed such as to create the desired pressure, and then so proportion its width as to provide for the required air volume. Evidently, the velocity and corresponding pressure may be obtained either with a small wheel running at high speed or a large wheel running at low speed. But if the diameter of the wheel be taken too small, it may be impossible to adopt a width, within reasonable limits, which will permit of the passage of the necessary amount of air under the desired pressure. Under this condition it will be necessary to run the fan at higher speed in order to obtain the desired volume. But this results in raising the pressure above that desired, and in unnecessarily increasing the power required. On the other hand, if the wheel be made of excessive diameter, it will become almost impracticable on ac-

count of its narrowness. Between these two extremes a diameter must be intelligently adopted, which will give the best proportions.

"When a fan is employed for exhausting hot air or gases, the speed required to maintain a given pressure, difference is evidently greater than that necessary when cold air is handled, the difference being due to, and inversely proportional to, the absolute temperature."

Induced Draft

With induced draft the smoke flue connects with the inlet of a large exhauster, which forms a partial vacuum and sucks the air and gases out into the stack. The fans are sometimes driven from the main line of shafting by a small belt, sometimes by a small steam engine, and again by an electric motor. There should always be an arrangement whereby the flue gases may be by-passed around the fan that it may be possible to make any repairs and clean out the fan when necessary.

A good system of induced draft has all the advantages pointed out under the general heading of mechanical draft, and its one great disadvantage is the constant daily cost of operating and maintenance. Before installing a system of this kind these items of expense should be carefully studied and the liability of ever wishing to move the power house given due consideration. The cost of operating the fan will be much greater in some instances than in others, and every installation must receive individual attention, taking advantage, however, of results already obtained by existing stations using similar apparatus.

Forced Draft

Systems of forced draft, like the induced system, have many different modifications. The fan may be placed in any convenient location and the air conveyed to the ash pit by a large sheet-iron pipe entering at the side of the boiler. With this method, special plates and dampers are supplied which convey the blast underneath the grates. Sometimes it is thought best to build an air duct underneath the boiler-room floor in front of the boilers, and in this way supply the blast at the front through dampers operated by hand rods near the boiler doors. With all systems of forced draft there must be some convenient way of shutting off the blast whenever it is necessary to stoke the fires or remove the ash, for without this much dirt and possibly more or less hot coal would be blown out into the boiler-room.

The cost of operating a fan with the forced system is practically the same as with the induced arrangement, because, although the volume of air supplied is less than that handled by the fan with induced draft, the hot gases are much lighter than the cool air, and the weight of air moved in each case is about the same. It is sometimes possible to use heated air for the forced blast, which introduces greater economy.

Balanced Draft

The object of balanced draft is to obtain a neutral or zero draft over the fire, so that when the fire doors are opened, there is no inrush of cold air against the boiler shell, nor, on the other hand, is there any outward flame to cause trouble. The expense of a combination of the forced and induced systems of draft need not be great, and it is probable that the balanced system may, in the future, replace some of the other methods of artificial draft.

Boiler Feed-Water

The advantages to be gained by supplying feed-water to steam boilers at a high temperature are easily understood by all interested in the economical generation of steam. In spite of this fact, we frequently find power plants giving the question of properly heating feed-water an exceedingly small amount of careful attention. The surface condenser may be utilized as a feed-water heater as well

as for condensing the exhaust steam, but among the textile mills the jet type of condenser is found in large numbers.

The feed-water heater is an important part of the power station equipment. All heat that can be imparted to the feed-water before it enters the boilers is just so much saved, both in cost of fuel and boiler capacity. By the term "feed-water heater," we mean any kind of an arrangement whereby the temperature of the boiler-feed water may be raised. We define this term for the reason that we wish to include economizers as well as the steam heaters.

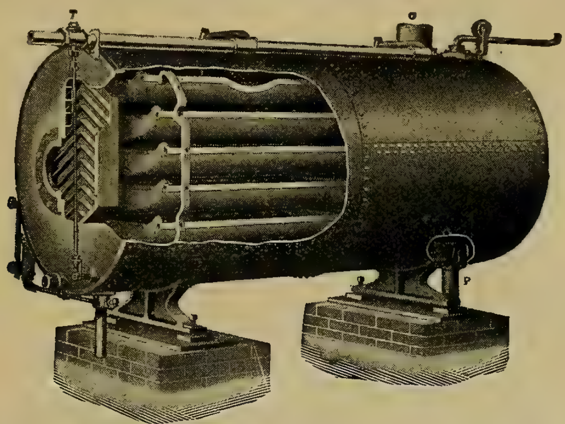

Fig. 1. Open Feed-Water Heater and Purifier.

Wasted Heat

With the most economical boilers known, there is a large percentage of heat wasted, and any type of apparatus which can utilize some of this wasted heat in a practical manner is something which should be made use of. There are three ways in which heat is often wasted at our power stations. First, it is frequently carried away in the exhaust steam from pumps, and other auxiliary apparatus; second, some portion of that contained in the exhaust steam from the main engine or turbine is often thrown away; third, hot gases are allowed to pass up the stack and into the air. It is true that there are comparatively few textile mill power plants where there is not some appliance for utilizing a part of the heat contained in exhaust steam, but there are numerous installations where this point is not given sufficient attention.

Heaters

Exhaust steam feed-water heaters may be divided into two classes, one being known as the open heater type, and the other as the closed. The open type is so constructed that the feed-water is exposed to the atmosphere, while with the other, the water is heated in a closed receptacle in which it is subjected to pressure. With a direct-contact open heater, the exhaust steam comes in contact with the water and has the disadvantage that oil in the steam may be taken by the feed-water and conveyed to the boilers. In a coil heater of the open type, the water is exposed to the atmosphere, but the exhaust steam circulates through a coil of pipes, the outside surface of which is in contact with the water.

With the closed exhaust steam feed-water heater, the water is heated by coming in contact with hot metal surfaces, which are generally groups of tubes or specially designed coils through which the steam is passed.

This style of heater is similar to a surface condenser, and as the steam and water do not come in direct contact with each other, there is no danger of the oil being carried to the boilers.

The quality of the available feed-water determines to a large degree the type of heater most suitable for any particular installation. With some kinds of water, the question of purification is of great importance, and the type of heater which can best remove scale-forming impurities and other foreign matter from the water is the one most suitable.

Purifiers

Figure 1 illustrates one form of water purifier and heater. It consists of a cylindrical shell in which are placed several shallow steel pans, as shown. The water enters at the top and flows into the upper pan from which it overflows and falls in thin sheets to the pans below. Steam enters at the top and heats the water by direct contact to nearly its own temperature. Impurities that are insoluble in the heated water are precipitated. Mud and earthy matter also settle out in passing over the pans, and the heated and purified water passes out of the heater at the bottom.

Figure 1-A shows one of the pans removed for cleaning and illustrates the manner in which scale-forming ingredients are precipitated and deposited.

With this type of purifier, the steam comes in direct contact with the water and if exhaust steam is used the question of oil being mixed with the boiler-feed is introduced. At some power stations this form of purifier is supplied with live steam taken directly from the boilers so that the feed-water may be purified without the danger of feeding-in cylinder oil. This method gives satisfaction so far as the purification is concerned, but does not make use of the waste heat in the exhaust steam. Oil separators can be placed in the exhaust steam pipe line before it reaches the heater, and if the separator succeeds in removing the oil sufficiently the results will be economical and desirable. There are many different form sof oil-removing devices upon the market, with some of which good results along this kind of work have been obtained. If a separator will properly separate, there is nothing to prevent the use of exhaust steam with the heater shown in Figure 1, but if the oil is not removed it will generally give trouble.

Fig. 1-A. Pan Removed from Open Feed-Water Purifier.

Cleaning

One head of the cylindrical shell shown in Figure 1 is removable, and this allows the occasional cleaning of the collecting pans. Mud and various other suspended foreign matter will precipitate inside the pans, and the scale will usually form upon the out-

side of the pans. When cleaning the pans from this style of heater they should be cleaned as soon as they are exposed to the air, for if left for some time where the atmosphere can come in contact with them, the scale becomes hard and much more difficult to remove.

The practice of putting kerosene into the boiler feed-water was mentioned in a previous issue of the American Wool and Cotton Reporter.

Figure 2 shows a feed-water purifier and heater designed for exhaust steam without the use of an independent oil separator.

Heater and Separator

The exhaust steam enters from the side, near the top, and comes in direct contact with the water which flows over trays, and thus exposes a large surface. The heated water falls to the bottom part of the heater, and is filtered through a thick

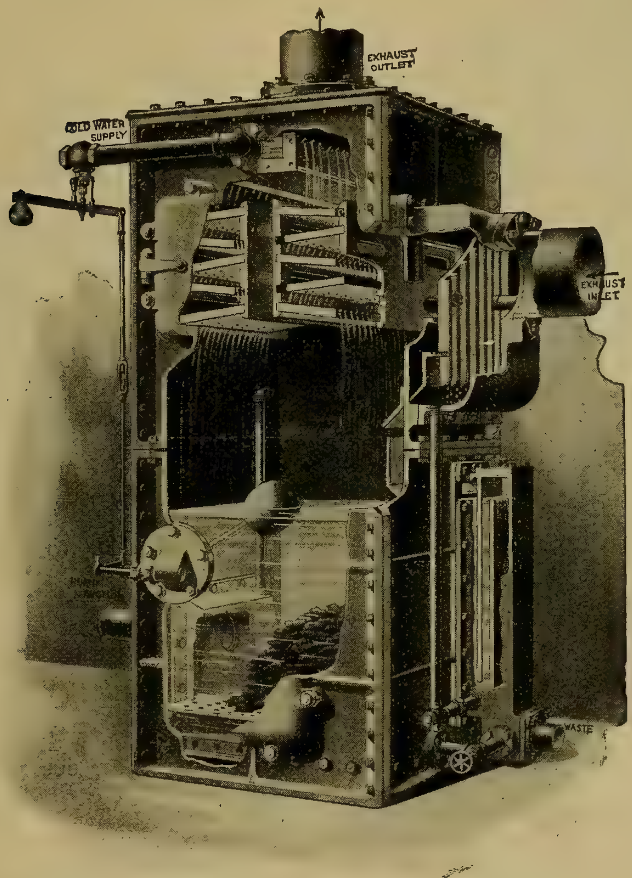

Fig. 2. Open Heater and Oil Separator.

Kerosene has the effect of loosening scale and preventing its adherence to the tubes. When this is done, the kerosene should be added before the water enters the heater.

layer of coke, after which it is pumped to the boilers. The exhaust steam, which is not condensed, leaves the heater by a pipe at the top of the heater. The water level within this

purifier is maintained practically constant by a special valve mechanism controlling the supply of incoming cold water.

Heaters similar to that just described have a certain advantage on account of bringing the exhaust steam into actual contact with the water to be heated. Considerable of the steam is condensed, and this decreases the amount of feed-water required. The greater part of the impurities will settle out of the water while it is in the heater, and cannot therefore cause trouble in the boilers. The oil extractors, whether combined with the heater or entirely separate apparatus, must be of such design as to do their work properly when this type of heating and purifying feed-water is in use.

Closed Heaters

Some closed heaters pass the feed-water through coils of pipe, while in other makes, these coils are replaced by nests of straight tubes. The coil arrangement provides an excellent heating surface, but its use is not advised with water that will precipitate sediment or scale-forming matter of any kind, unless there is some special proviso for removing these impurities. Heaters having the straight tubes should be made with ample sediment chambers, and when they are properly designed, they can handle satisfactorily water which contains considerable amounts of organic or earthy matter. Carbonate of lime sometimes combines with certain earthy impurities, and forms a hard scale, and while organic matter can be taken care of by this type of heater, it should not be used where scale-forming ingredients are present.

Placing Heaters

Much of the heat in exhaust steam from main engines or auxiliary apparatus can be saved by the proper use of one or more exhaust steam feed-water heaters. With non-condensing engines, the steam from the engine itself should generally be passed through some form of feed-water heater. With condensing engines, it is sometimes wise to pass the exhaust steam through a closed heater on its way to the condenser, but frequently the exhaust steam from steam pumps and various auxiliary steam-driven units supply enough steam to heat the feed-water to a temperature as high as can be obtained from the use of the steam which is on its way to the condenser. Often feed-water is heated to 100 or 125 degrees by a heater placed in the main exhaust line from an engine and is then passed to another heater receiving steam from auxiliary apparatus. No hard and fast rules can be laid down concerning the installation of water heaters, for conditions differ greatly in plants where the nature of the work demanded seems quite similar. A good thing to always remember is that heat may be easily wasted in exhaust steam, and to prevent this waste, it is necessary to have this matter investigated by some engineer who can determine with accuracy whether the best possible economy is being obtained.

Economizers

Economizers are generally used for heating boiler feed-water, although in some special cases the water heated is used for other purposes. They provide a means of storing a large quantity of water at a high temperature which can be delivered to the boilers quickly in times of sudden demands for steam. Exhaust steam feed-water heaters make it possible to supply water to the boilers at a temperature of about 200 degrees Fahrenheit, while with an economizer water can be heated to a temperature of 250 to 300 degrees Fahrenheit.

To be sure, it is not possible to utilize the heat of the flue gases without meeting with undesirable features. Placing an economizer in the path of the hot gases offers a certain resistance, and, consequently, reduces the available draft. Natural draft is produced by the tendency of heated vapors to rise, and the cooling of the gases by the use of an economizer de-

creases this. The draft problem can readily be settled when a new power plant is being designed, and the effect of the economizer considered when deciding upon the height of the chimney, or where used, the type of mechanical draft. Placing economizers in plants already built does reduce somewhat the draft, but when they are properly installed, the coal consumption will be decreased enough to reduce the operating expenses of their plant. These are apt to be the same men who insist that the old-fashioned fire-tube steam boilers are the ones to use for fairly high steam pressure work now being required for power units in textile mills. Fire-tube boilers are cheaper, perhaps, in initial cost, but for modern stations, they are being superseded by those of the water-tube type.

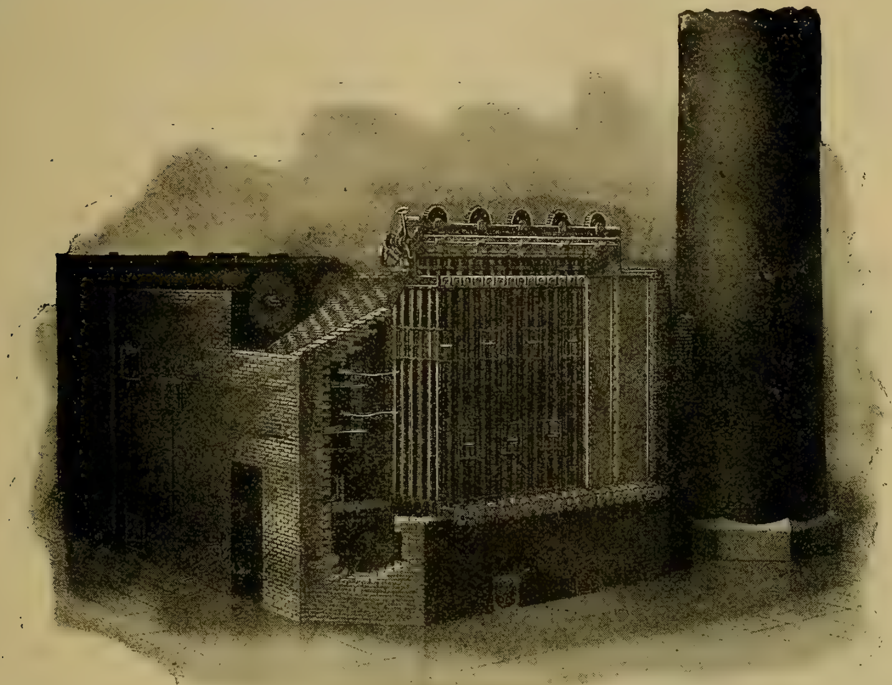

Fig. 3. A Typical Economizer Installation.

in part counterbalance this point. Often less draft will be needed, because it becomes necessary to burn less coal.

Not Complicated

The general arrangement and principles are understood somewhat by nearly all men interested directly in the operation of the power end of a textile mill, but there are some who look upon economizers as complicated mechanisms, which will increase rather than

It is likewise cheaper in first cost to omit the installation of an economizer, but it is the operating expense which should govern the matter. Economizers consist of rows of cast iron pipes. Each of these rows are connected at the top and bottom to cast iron headers, through which the water is supplied and withdrawn. More or less soot would collect upon the outside of the pipes and insulate them from the heat in the gases, if some method were not employed for cleaning them. A special scraper en-

circles each of the tubes, and by means of simple mechanisms these cleaners are continuously kept moving up and down. With economizers, there should always be a by-pass flue, so that when desired the gases may reach the chimney without going through the economizer.

An Installation

Figure 3 indicates one of many ways in which economizers can be installed, and Figure 4 shows a cross section taken through an economizer chamber. Both of these illustrations show the scrapers clearly. It will be seen that

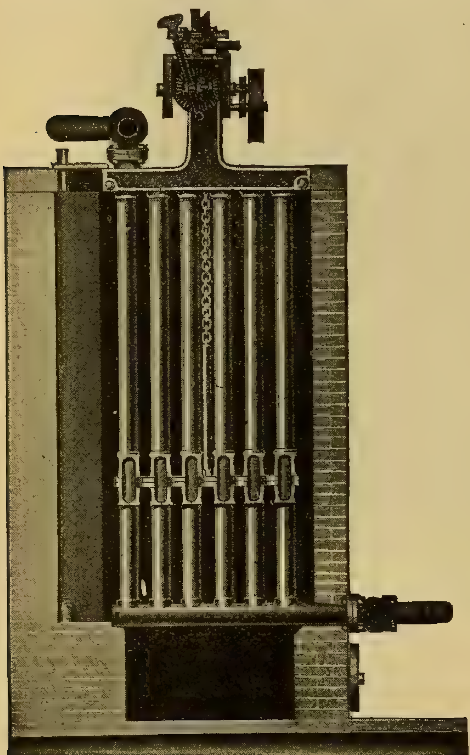

Fig. 4. Economizer Chamber.

every other scraper is near the top of the pipes, while the others are near the bottom. One set of scrapers just balances another set, so that the power needed to operate them is slight. At the bottom of Figure 3 the pipe known as the access pipe can be seen, and this is shown in detail by Figure 5. These manifolds have cleaning openings opposite each branch of pipes, which make it possible to thoroughly clean the bottom headers and branch pipes.

The Flue Gas

It has been pointed out that, with the most economical boilers the gases will be cooled by the heating surface of the boilers themselves to about 400 degrees Fahrenheit. No doubt this is the case with well-proportioned boilers operating under the most economical load, but owing to the accumulation of soot upon the heating surfaces, and the many times that boilers are forced at a higher rate of evaporation than is normal, the temperature of the waste gas usually exceeds the above figure, and the economizer becomes of value even with boilers of the most economical design.

We have already spoken of the value of a good oil separator in connection with arrangements where it is advisable to return the condensation of the exhaust steam to the boilers. Separators are upon the market which are designed to remove either oil, water, or both of these from steam.

Dry Steam

No engineer would for one moment think of running a steam pipe from the boilers to the engine without having it covered with some substance which will prevent the radiation of heat. In considering the best arrangement for boilers the American Wool and Cotton Reporter has emphasized the importance of placing all equipment so that the length of steam pipe might be as small as possible. Unless steam is superheated there is sure to be some condensation in the pipes connecting the boilers with the power units, and for removing this water we may employ some form of a steam separator.

It is impossible to mention here all of the various styles with which good results may be obtained, but one or two types will be considered briefly.

Removing Moisture

Moisture is carried along with the steam in the form of small particles or drops of water which are much heavier than the steam itself. Due to the greater weight of the moisture it moves with a much greater inertia than the steam. By causing the steam to flow over various systems of baffle plates, the inertia of the moisture tends to prevent it from changing its course and the water collects upon the plates, from which it is removed through a suitable drip pipe.

Fig. 5. The Access Pipe.

The Venturi meter is a device for measuring the flow of liquids which does not depend upon any float, paddle-wheel arrangement or other moving part in contact with the liquid.

Venturi Meter

If the pipe through which the water flows has its inside diameter gradually tapered until it is much reduced, and is then enlarged back to the original size, the water will, of course, have a greater velocity through the section with a small diameter. Due to the increased velocity, the pressure at this section of small pipe will be less than in the main pipe, and by using a reducing section, which is carefully and accurately made, it is possible to determine the quantity of water flowing by recording the pressure in the throat or reduced section of pipe, and that in the main line just before the diameter is reduced.

The diagram shown by Figure 143 illustrates the principle employed by the Venturi meter, and if the tapering pipe and throat B are properly proportioned, there will be almost no loss of pressure caused by the introduction of this measuring device. The pressure of the outlet C increases on account of the decrease in velocity, and practically the same amount of water will be delivered through a tube of this kind as would pass through an equal length of straight pipe of uniform diameter. There will be, however, a temporary loss of pressure at B, and this has been found to increase approximately as the square of the throat velocity. If the velocity at B is twice that at A, the pressure will be one-fourth as great at B as at A. By determining the velocity of the water through the throat, and knowing the cross section of the tube, the quantity of the water can readily be figured.

The principle of the Venturi meter is not new, but recording and indicating attachments, which are necessary to make the apparatus practical for mill work, have been improved and meters of this type are now in use in many of the large textile mills.

Used by Textile Mills

Among these are the Bates Manufacturing Company, Lewiston, Me.; the Grey-

stone Mill at Greystone, R. I., and the textile machinery plant of the Whitin Company at Whitinsville, Mass.

Two small pressure pipes are carried from the throat and inlet chamber, respectively, and the mechanism for indicating the amount of water passing through the tube may be placed at any convenient location in the engine room, boiler room, or in both places. Any arrangement which indicates the difference in pressure at the points B and C, Figure 143, can be read against a specially graduated scale which will give directly the gallons of water flowing through the tube.

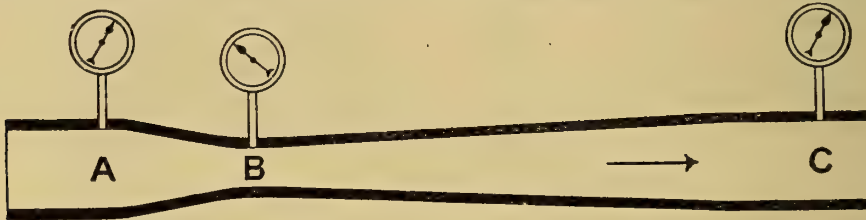

Fig. 143. Diagram Indicating Principle of Measuring Hot Water with the Venturi Meter.

In its simplest form the indicating device consists of a U-shaped tube partially filled with mercury, one opening being connected with the pressure pipe from the throat and the other with the pressure pipe from the inlet chamber. For commercial purposes it is desirable to know the amount of water flowing through the tube per hour or per day, and by a simple clock attachment, a recording device has been arranged which will give this information. In connection with this attachment, a chart recording dial has also been designed, so that the complete attachment contains apparatus for giving a graphical representation of the amount of water flowing at all times, a counter dial, which shows the amount of water used from the time the apparatus is connected, and an indicating dial, showing the rate of flow.

The chart recorder dial gives a continual autographic record of the rate of flow through the meter tube. All irregularities together with the time and extent of each, are shown, and this furnishes the chief engineer with a daily check on the operating efficiency of the plant. The counter dial shows the total pounds, cubic feet or gallons that have already passed through the meter tube. By checking this reading against the coal burned for the same period of time the evaporation per pound of coal is readily determined. This makes it possible to try out different kinds of coal without weighing the feed water in tanks. The indicator dial may be graduated so that it will read in pounds per hour, cubic feet per hour, or any other convenient units.

Uniform Boiler Feed

The chart made upon one of these shows whether the water is being delivered to the boilers uniformly or not, and if the amounts taken vary, that is, if the boiler is given a large amount of water for a short time and then the supply is almost entirely cut off, it calls attention to this irregularity. If large quantities of water are suddenly forced into the boiler this water will be insufficiently heated and will cause a consequent loss in economy. By watching the meter indications, the fireman can so regulate the feed valves that a more even feeding will take place and the water enter the boiler at a higher temperature.

The one main point to be considered by the mill man before installing

one of these arrangements is its accuracy. The fact that the hot water does not come in contact with any moving parts eliminates the danger of the apparatus being warped by the high temperature and the tube itself is lined with bronze or composition metal which will not be affected by the warm water. An interesting test was recently made to check up the accuracy of this measuring device, and results obtained with the Venturi meter were compared with the actual amount of water used as determined by weighing tanks. The general arrangement of the apparatus for this series of tests is shown by Figure 144.

Its Accuracy

The trials were made under varying temperatures and velocities; under varying pressures, intermittent and steady; using a triplex power pump in good condition, and with one plunger out of commission. A duplex steam pump in good condition was used, also one in poor condition, and an injector. The reason for trying these different pumps was that different conditions which are met in actual boiler room practice might be studied.

The main part of the meter was of cast iron, and all internal portions were lined with brass. Surrounding the up-stream portion and throat were angular chambers between the brass sleeve and the iron casing. Six holes were drilled through the brass lining into these angular chambers at about equal distances around the circumference, in order to give the actual pressure heads in the meter at both throat and up-stream end. From the outside of these angular chambers there were pipes connecting to glass U tubes containing mercury.

The apparatus was connected up so that the meter could be supplied from a 1¼-inch injector, a 4½ by 2¾ by 4 inch duplex pump, or a 4 by 5¾ inch triplex power pump or from a pressure tank supplied from the city mains. These pumps were arranged to take their suction from a pit 12 feet long, 6 feet wide and 4 feet deep. This pit was placed directly beneath the Venturi meter, and a 1-inch steam line put in to heat the water. The pit held about 300 cubic feet of water, and it was thus possible to maintain an even temperature. The discharge from all pumps was carried up a vertical 2-inch pipe, at the top of which was an air chamber 4 inches in diameter and 3 feet long. (See Figure 144.)

A Laboratory Test

For making comparisons of the accuracy of the meter under varying temperatures, a coefficient was first obtained by using cold water, that is, the constant was obtained by which the meter reading had to be multiplied in order to give the actual amount of water. It must be remembered that this coefficient or constant is always obtained by the makers of the apparatus, and the indicating arrangement designed so that the dial readings show corrected values. Therefore, the variations in coefficients obtained indicates the change in accuracy which might be expected with this apparatus when used with water at different temperatures from those for which it is calibrated.

With a range of temperatures from 40 to 200 degrees Fahrenheit the coefficients were found to change only 0.028. The maximum errors in discharge, as figured from the mercury column deflections, were found to be as follows: with water at 80 degrees, 1.39 per cent; 120 degrees, 1.5 per cent; 140 degrees, 1.9 per cent; 180 degrees, 0.82 per cent.

Range of Temperature

The test made with the triplex power pump gave the best results, and even with one plunger disconnected the maximum variation was only 2.4 per cent. The meter was least reliable when pulsations were present, and when the throat velocity was less than 10 feet per second. The type of instrument used for actual mill service differs from the apparatus used for this test in ways which largely overcome this trouble.

Mill Tests

The instrument used during the test for indicating the pressure consisted of a glass tube partially filled with mercury. This tube contained only about one pound of mercury. The inertia was, consequently, small and the mercury levels unsteady. The apparatus used in mills contains nearly one hundred pounds of mercury, which has a damping effect and makes the readings steady. The scale from which readings of the mercury columns were taken at the test had its graduations close together at low velocities, and in the registering instruments, designed for mill use, the movement of the mercury is multiplied by a system of levers.

A series of tests carried on in a large power station to determine the accuracy of the Venturi meters in actual operation at that plant showed, on a seven-hour run where about 170,000 pounds of water was fed to the boiler, that the meter reading exceeded the water weighed by 631 pounds, or approximately 0.37 of 1 per cent. In another test, in which 200,000 pounds of water was fed, the difference between the results obtained by weigh-

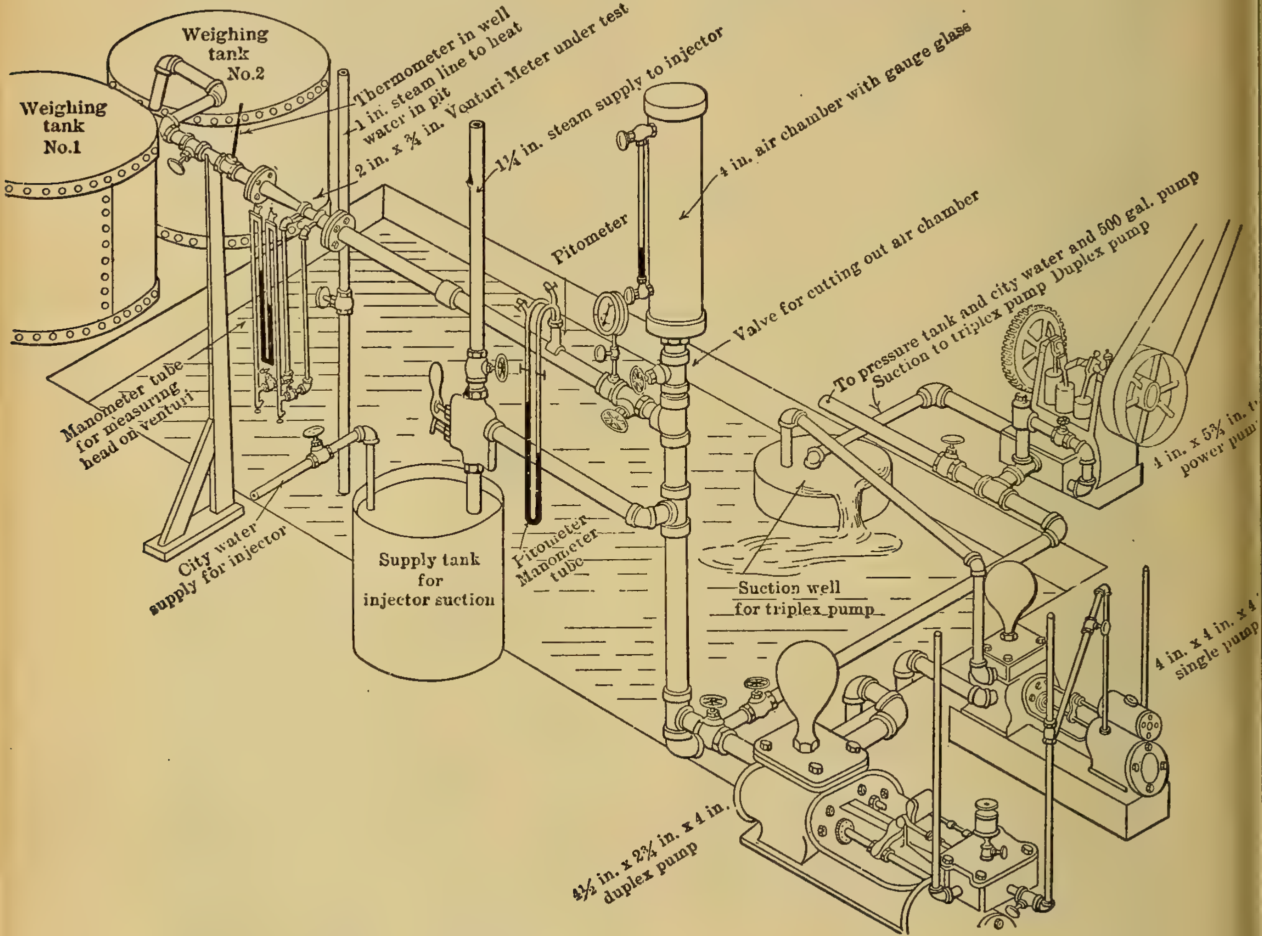

Fig. 144. Apparatus as Arranged for Laboratory Test of a Venturi Meter.

ing the water in tanks and those taken from the meter reading was 0.47 of 1 per cent. Those in charge of this series of tests state that they believe the results from the meter were fully as accurate as those by the weighing tank, for with the weighing tanks, there was considerable opportunity for evaporation to take place.

Steam Separators

Certain types of separators impart a rotary motion to the mixture of steam and water, and the heavy particles of moisture are thrown out by centrifugal force. There is also a form of separator which operates in much the same way as the one first mentioned except that instead of regular baffle plates the steam passes through a system of gratings arranged so that the bar of one grate or screen is behind a space of the screen in front.

Figure 6 is a sectional view of this last type of separator, and shows the staggered arrangement of the plates or grates. Figure 7 is a view of the outside of this same device and shows one of the plates partly removed for cleaning. The moisture in the steam is deposited upon the bars of the special gratings and then runs by gravity into the drip pipes provided.

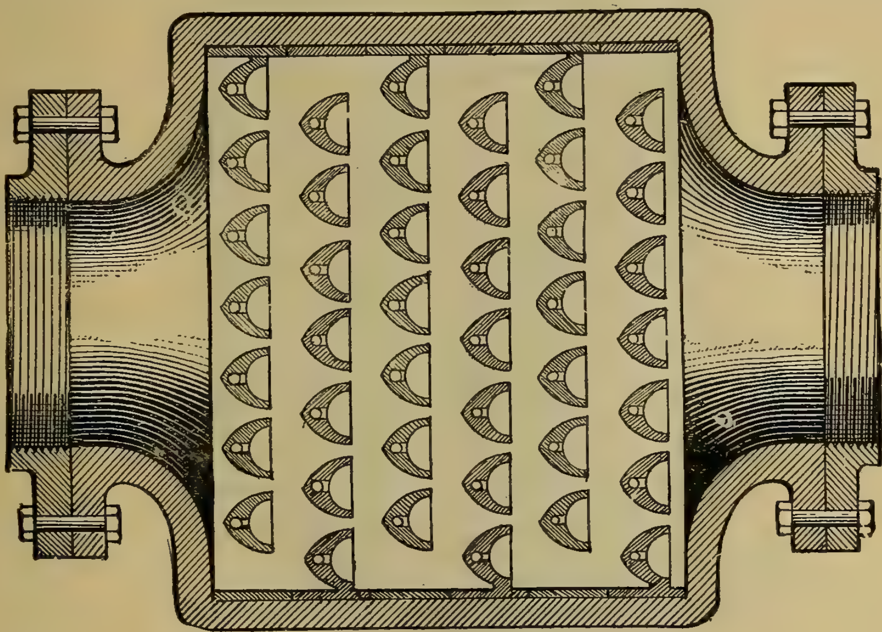

Fig. 6. Sectional View of Separator.

Oiling Systems

Power stations connected with textile mills, whether large or small, should have proper attention given to the subject of oiling systems. It may not be wise to expend a large amount of money for this purpose in old plants, and the proper arrangement for these stations will not require large expenditures. A complete oiling system collects the oil from the bearings, filters it and returns it again for lubrication. If some means is not provided for saving the oil which drips from the various bearings of a prime mover, it is safe to say that 60 to 75 per cent of the oil will be wasted.

Few, if any, of the power plants of our textile mills fail to provide some sort of a method for saving oil, but there is much chance for improvement in many of the methods employed. We should not discourage for a moment the use of waste for oil-

ing machinery, but oftentimes oil is wiped up with waste, which is afterward burned when a suitable drip pan could easily be arranged to prevent this loss. Engines should by all means be kept clean, and waste which has absorbed any considerable quantity of oil should be put through some form of extractor, and the oil saved instead of being burned.

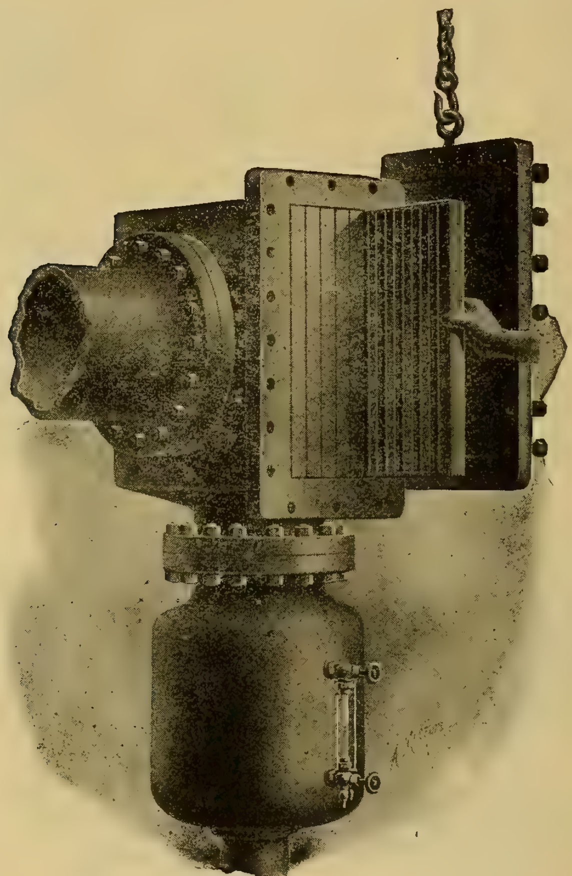

Fig. 7. One Type of Separator.

In many instances, the amount of oil soaked up by waste will seem small and unimportant. In a few instances this is true, but ordinarily the amount thus used is large. In a certain mill, for example, all oily waste was sent to the boiler room and burned. This concern consumed 28,000 pounds of waste each year, and, as much of it was used for wiping the engines and oily machinery, it was heavy with oil. An expert who investigated the general conditions of the whole station reported that at the very least 2,000 gallons of oil were being wasted every year. By using an oil extractor this oil could have been saved and the waste itself washed and used again.

Oil Soaked Waste

Several good types of machines are made for removing the oil from waste. One form makes use of the centrifugal tendency which causes the oil to leave the waste when it is given a rapid rotary motion. The machine is

really a small steam turbine, and the strainer in which the oily waste is put is caused to rotate with great velocity. The oil is thus thrown outward through the strainer and falls down into a suitable tank.

lustrated is designed to remove this as well as other foreign matter. The oil enters at the top, percolates down through the waste in the central compartment, and then descends still further through a pipe as indicated in

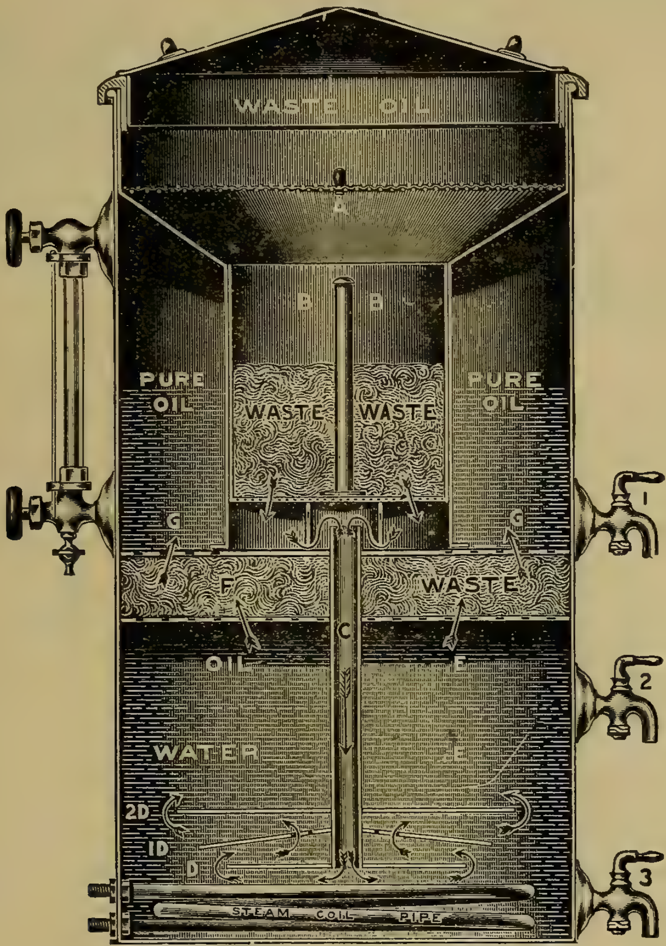

Fig 8. Oil Filter.

Oil Filters

Oil, which has been delivered to the bearings and is collected by the system of drip pans, should be well filtered before being again fed to the engines. Figure 8 shows a sectional view of an oil filter manufactured by the Burt Manufacturing Company. Frequently, the oil returned to the filter contains more or less water, and the filter illustrated the figure. Leaving the pipe at the bottom, the oil comes in contact with water, through which it rises and collects in the space allowed for pure oil near the top of the filter. In passing from the water to the oil tank it is caused to once more filter through a layer of waste.

Oil will filter more rapidly when warm, and the filter shown in Figure 8 indicates a steam coil which is used

to heat the oil and water through which it rises.

Location

The filtering tanks should, if possible, be located so that the oil will flow into them by gravity, and they should be placed in a building which is either fireproof or so situated that the danger from fire will be small. With power plants such as many of our larger textile mills demand, it is advisable to give this point careful attention, and even with the small stations, all oil tanks and filters should, if possible, without too much extra expense, be located in fireproof buildings.

Gravity Feed

In speaking of oiling systems which may be installed within a new power station for any textile mill, it is well to call attention to the simplicity of gravity-feed systems for delivering oil to the numerous bearings on engines in power plants already built and in use. It is a simple matter to equip an old engine with a system of gravity oil feed, and its use will frequently reduce labor cost in the engine room considerably. By placing an oil tank in some central location, high enough to make possible a feed to all bearings by gravity, piping can readily be installed so that whenever oil is in the supply tank, each bearing will receive the proper amount of lubrication. A small pump may be arranged to carry the oil to the tank, and a by-pass can be used so that the pump may be operated continuously, regardless of the oil level in the tank. Some engineers object to a system of this kind, on the ground that some of the pipes are liable to become clogged and the oil supply cut off from an important bearing without warning. The pipes may be arranged so that the oil has to drop a certain distance when entering each bearing, and with this design a glance at any oil cup will tell whether it is receiving its proper amount of oil. Again, if properly filtered oil is used and the piping installed as it should be, there seems to be little reason why trouble should result.

Air Leaks

The admission of cold air to the boiler flues must of necessity check the fire. Every one is aware that the ordinary house furnace fires are checked by opening an air draft in the smoke pipe, but people frequently forget that the same principles hold true regarding the fires under mill boilers. It has already been pointed out that all flues should connect with the chimney in as direct a manner as is possible, and that bends should be made as easy and gradual as circumstances will allow. Boiler flues, when carefully designed, must frequently be made of considerable length, and whether they be long or short, they should be maintained perfectly air tight.

Even small leaks will admit enough air to seriously affect the draft, and there is no excuse whatever for their existence. A case which recently came to the writer's attention illustrates the bad results caused by these small leaks. The draft at the base of a certain chimney was one inch by the water gauge, and due to a leaky flue, the same gauge registered but one-fourth of an inch at the boiler. The flues should have several doors through which they may be cleaned, and it is at these doors that much cold air is often unnecessarily admitted.

The average master mechanic of our textile mills knows that the flues should be kept tight, but he frequently does not realize the harm that the small leaks will introduce. New flues are as a rule made fairly tight, but they should never be accepted as satisfactory until carefully tested.

At some mills, the writer has seen flues from small forges or other fur-

Branch Flues

naces used in the machine shops connected with the main chimney. While these small fires are in use, it is doubtful whether the draft is in any way decreased, but as a rule, these small fires are

and at the same time be tight fitting. Those regulating the draft for the boilers are often arranged to leave an opening sufficient for the gases to escape rather than to return to the boilers even when the damper is closed.

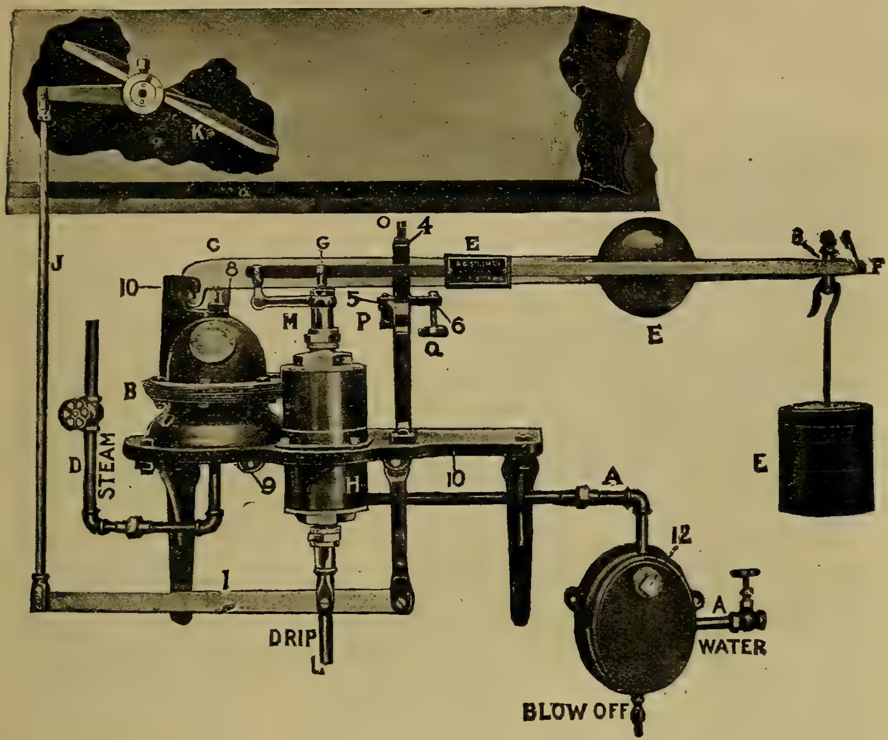

Fig. 9. Automatic Damper Regulator.

used only at certain intervals, and cold air is allowed to flow unrestricted to the chimney at all other times. Dampers can be installed which may make the arrangement satisfactory, but often no attempt is made to properly close these flues when they are not in use.

What has just been said about flues from small auxiliary furnaces applies equally well to all branch flues connected in any way with the main chimney. Where more than one flue enters the chimney, each one should be provided with an efficient damper so that repairs will not necessitate the shutting down of the entire plant. These dampers should operate easily

Automatic Dampers

Dampers used only occasionally at times of repairs, etc., should be operated by hand, but the ones used regularly for governing the fires can be arranged to operate automatically with increased economy. These automatic dampers are operated by the changes in steam pressure, and can be adjusted so as to insure uniform pressure during the ordinary running conditions as met with in the textile mills.

Figure 9 illustrates one type of automatic damper regulator, and indicates clearly the way in which the damper is moved. A small steam pipe from the boilers communicates the

boiler pressure, and any changes in this operates a valve which admits water into a small hydraulic cylinder. The water acts upon a piston, which by means of the system of levers shown moves the damper. By use of adjusting weights, the apparatus can be so balanced that small changes in the steam pressure will change the draft and give satisfactory and uniform results.

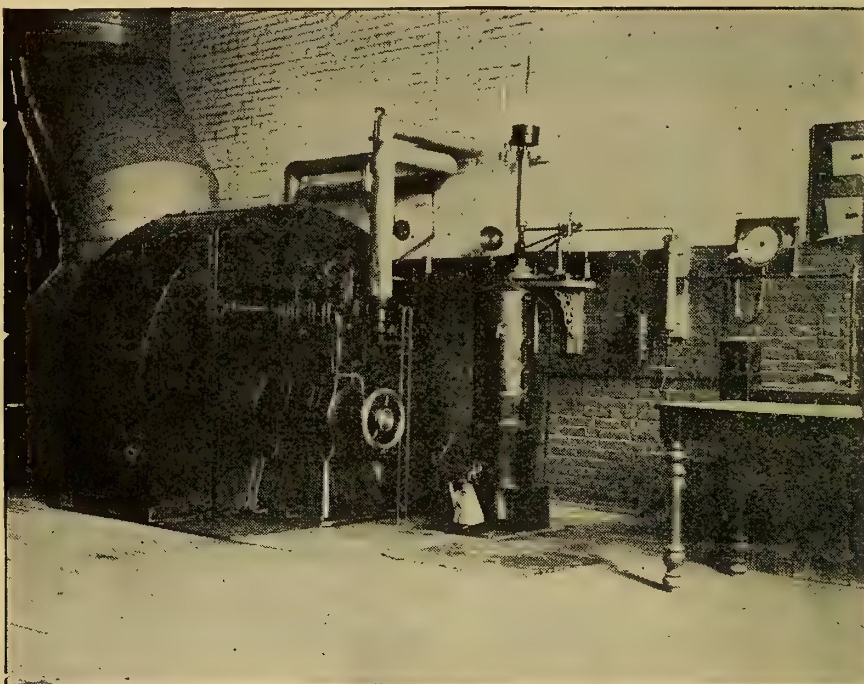

Fig. 10. Forced Draft Fan Controlled by Damper Regulator.

Mechanical Draft

When mechanical draft is employed it is customary to control the system by the same automatic regulator that operates the damper in the flue. Whether the draft be produced by the induced or the forced method, the speed of the fan, or fans, can readily be changed by the damper regulator.

Figure 10 shows a forced draft fan as it is arranged in one of our New England textile mills. The small steam engine which operates the fan can be seen clearly, and the automatic damper regulator is fastened to the brick wall behind and just to the right of the fan. Near the steam pipe leading to the engine a lever can be seen, which operates the throttle of the engine and which is connected to the damper regulator.

Operation

As the steam pressure within the boilers increases, the regulator closes the damper in the flue, and at the same time operates the steam valve controlling the engine so that the engine is slowed down. If the steam pressure falls below a certain point the damper is moved and the throttle of the blower engine is opened. With systems of induced draft the speed control is arranged in a similar manner.

In some of our power plants electric motors are used for driving mechanical draft apparatus, and in these in-

stallations the damper regulator is connected to a suitable electric controller so that the results are the same as in the case just described. It will be remembered that the American Wool and Cotton Reporter has described existing power stations where induced draft fans were in use which always ran at constant speeds. This arrangement is found only where the fans are driven by belting or ropes from the main engine, and its use is seldom advisable. When the damper closes, due to increased steam pressure, the draft caused by the suction of the fan is not wanted and power is wasted. More or less hot gas will also be drawn up the stack when the damper is closed with constant speed fans, and this introduces a loss of valuable heat units.

Low-Pressure Turbines

Low-pressure turbines, as their name implies, are those operated by low-pressure steam. High-pressure turbines are generally referred to when the term steam turbine is used, but there are many uses for units operated by exhaust steam. The advantages of electric drives for textile mills are many. Alternating current motors are the ones best suited for most branches of the textile industry, and the high speed of steam turbines is especially adapted for driving alternating current generators.

Mention has been made in the American Wool and Cotton Reporter of many power plants where power is developed by turbines. One of the generating units installed in the new power plant of the Royal Weaving Company, Pawtucket, R. I., has been described and a cut of the turbine shown. The mills of the American Thread Company at Fall River are driven by steam turbines, the Tremont & Suffolk Mills at Lowell have several in use; and, in fact, nearly all of the large textile mills which are employing electric drives are making use of the steam turbine. Turbine units are in use at the Boott Mills, the Massachusetts Mills, the Amoskeag Mills, the Pacific Mills and in hundreds of others.

Power Costs Reduced

Low-pressure turbines are generally employed for generating comparatively small amounts of power. This in no way signifies that they are unimportant. There are many mills where the installation of a low-pressure steam turbine would reduce the cost of power. Exhaust steam from reciprocating engines, steam pumps, and other auxiliary apparatus can be delivered to low-pressure turbines which in connection with suitable condensers are capable of delivering considerable amounts of power.

Engines which are running non-condensing are discharging steam at atmospheric pressure. This is about 14 pounds per square inch. Steam turbines may be arranged to receive this steam at the atmospheric pressure and discharge into a vacuum of from 24 to 29 inches. With such an installation, the output may be increased from 75 to 100 per cent. The same steam used in the engine is given a second chance to do work, and this in no way increases the size of the boiler plant. The engine and exhaust turbine require no more steam than is demanded by the engine alone; therefore, there is no extra cost introduced for fuel, chimneys, coal handling apparatus and buildings.

Not Limited

The usefulness of the low-pressure turbine is not limited to plants where the engines are simple non-condensing units. Condensing engines may be arranged to exhaust into an exhaust turbine, and the turbine in turn will exhaust into the condenser. In many instances considerable extra power can be obtained with this arrangement without increasing the consumption of steam.

Mills often have single cylinder engines which have been installed with the idea of later putting in a low-pressure cylinder and compounding the unit. Instead of putting in the low-pressure cylinder, an exhaust

steam turbine can be arranged to receive the steam from the high-pressure cylinder and utilize its expansion powers by discharging into a vacuum of 24 to 29 inches. This plan may not always be advisable, but it should be given consideration.

be operated by it continuously. To accomplish this, a regenerator is employed. This is simply a heat storage reservoir which consists of a tank partly

The Regenerator

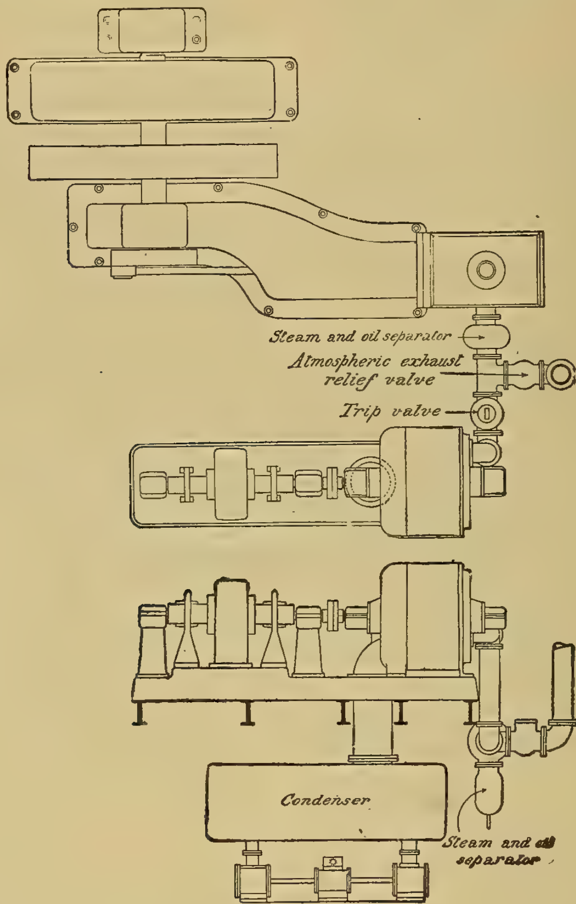

Fig. 44. Plan and Elevation of Low-Pressure Turbine Installation.

Figure 44 is a plan, an elevation of an exhaust turbine generator installation showing the connections and the relative proportions of the parts. A load of 300-horse power is carried by the engine, and the turbine supplies 200 additional horse power.

filled with water. The excess steam supplied at intervals is condensed by the water and re-evaporates, due to the drop in pressure within the regenerator when the exhaust steam supply is deficient.

If exhaust steam is available intermittently, a low-pressure turbine can

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Figure 45 illustrates one type of low-pressure steam turbine which is suc-

cessfully used in textile mills. They may be directly connected to electric generators, circulation pumps, or any high-speed apparatus. Figure 46 shows another make of exhaust turbine built for direct connection to centrifugal pumps. In some instances, it is desired to operate an exhaust turbine before the unit supplying the exhaust

Mixed Pressure

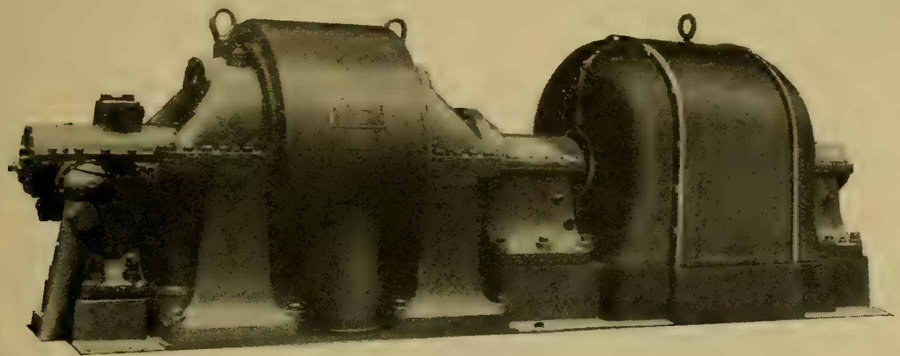


Fig. 45. A Typical Low-Pressure Steam Turbine.

steam is started. For instance, an exhaust turbine may drive a pump which circulates the condensing water for its own condenser. For such installations, a mixed pressure machine lends itself for use with either high or low-pressure steam. A mixed-pressure unit may be installed to utilize all of the exhaust steam available and automatically take high-pressure steam in quantities necessary to handle the load.

Commercial filtration plants have recently been described, and in the issue of April 6, the water softening and purifying apparatus as used by the Sauquoit Spinning Company, Capron, N. Y., was illustrated. Since the cotton industry first started, the advantage of locating mills near plentiful water supplies has been appreciated. The consideration of the kind of water available has frequently been neglected. The following inorganic substances are often found in water; carbonates and sulphates of lime and magnesia, silica, oxides of iron and alumina and suspended matter. All of this tends to form scales. Corrosion is brought about by the presence of sulphuric, hydrochloric, carbonic, acetic and tannic acid. Small amounts of these acids will cause practically no trouble, but acetic and tannic acids are frequently present in large quantities, due to contamination from near-by chemical works. Iron sulphate and magnesia chloride form a scale and cause corroding action as well. Carbonates, sulphates and chlorides of sodium and potassium are often present in a mill's water supply, but they seldom cause trouble. When water is heated to 212 degrees Fahrenheit and is boiled for some time, the carbonates of lime and magnesia are precipitated. These deposits will collect upon the boiler tubes or within the feed water heater or other various pipe lines and then cause serious trouble. Carbonates of lime and magnesia are poor conductors of heat. It is claimed that the conducting power of boiler scale is about one-thirtieth that of iron.

Softening Water

In speaking of the ill effects from non-conducting scale, J. C. Wm. Greth gives the following: "First, The increased amount of fuel which it is necessary to use in order to raise the temperature of the water to a given

Ill Effects

point or to generate steam. Second. There is great danger of burning or overheating the boiler, by reason of the fact that the water is not in immediate contact with the shell and cannot carry off or absorb the heat from the plates. The boiler being under pressure, the overheating of the metal results in the stretching of the plate, forming a bag; or the metal may blister or crystallize, which will very much reduce its tensile strength, rendering the boiler unsafe. This means cumulating. It is usually very hard, and can only be removed after considerable hard work. Continual hammering and chipping is injurious to the metal, and even if the intentions of the cleaner are the best, it is impossible to reach all parts of the modern steam generator for cleaning. Third. The boilers are not the only part of the steam generating plant which are affected by the impurities of the water. A deposit of a part of the carbonates of lime, mag-

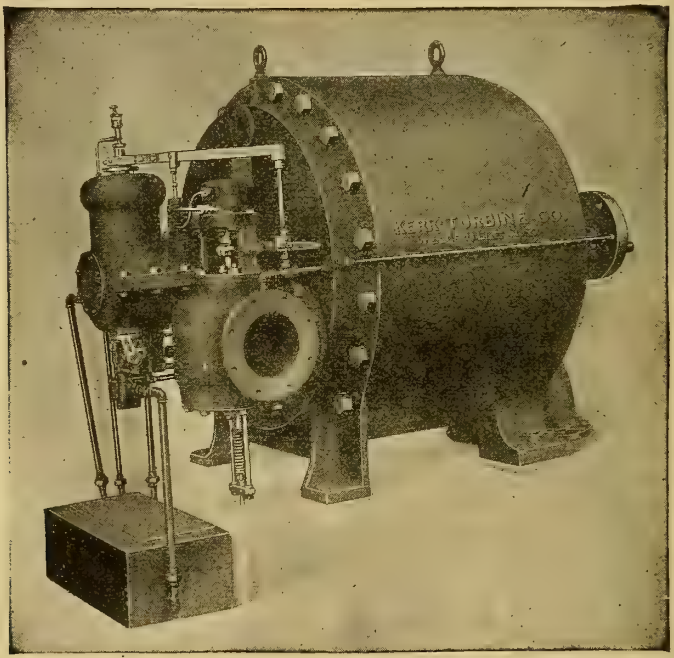


Fig. 46. An Exhaust Turbine for Driving a Centrifugal Pump.

repairs are in order, even in cases where the metal does not get heated enough to bag or blister, but is sufficient to cause the metal to expand unequally, distorting the seams and joints between the several parts of the boiler. This causes leaks, which, in time, become serious enough to put the boiler out of use. Even under conditions where no disastrous results follow, a great deal of labor on the part of the engineer in charge is necessary to keep the scale from ac- nesia and iron takes place when the water reaches the exhaust steam heater. The same trouble arises in steam plants using economizers on heaters through which the water passes after it leaves the exhaust steam heater, and before it reaches the boilers. These obtain their heat from the waste gases of the furnace. and it is very important that their surfaces should be clean and kept so without involving a great deal of labor and expense. A deposit, too,

especially from well waters, takes place in the feed pipes, valves, pumps, etc."

Various Methods

Operating engineers in textile mills all have various methods for preventing too great an accumulation of boiler scale. Some of these methods work satisfactorily, while others are unnecessarily expensive and give poor results. In some instances, mills have discontinued the use of pond or river water and are now purchasing boiler feed from the municipal water works. Purchasing city water for mill use is expensive and many times a scientific investigation of the river or pond water would show that this water could be economically used.

Foreign matter which can be removed mechanically with filters has been removed by many plants. The methods of chemically softening water are perhaps less generally understood. It is not, however, an expensive and unsatisfactory process, as is proven by the many textile mills using one form or another of this kind of apparatus. Water can be treated with a definite amount of chemicals by mechanical methods. This makes possible a softening plant requiring little attention. Boiler tubes have become almost entirely filled with scale before trouble was suspected, and one case which we remember offhand required 100 new tubes. Scale which has been loosened by boiler compounds but not removed will sometimes reharden and cause much trouble.

Boiler Compounds

In speaking upon the subject of boiler compounds, Mr. Greth makes the following comment: "Mixtures known as boiler compounds have been used for years. The chemistry of boiler compounds is correct, and the subject is thoroughly understood. They are generally composed of soda in combination with some organic acid, such as tannic, acetic, etc. All of these acids are said to corrode the metal and to be positively injurious to the boiler.

"Almost everything, at one time or another, has been put into the boiler to keep the scale soft, such as shavings, oak bark and tea, for the tannic acid they contain; distillery slops and vinegar, on account of the acetic acid; potatoes and corn, for their starch; leather, slipper elm and manure, for their gelatinous matter; molasses and sugar, because of the saccharates of lime formed. Innumerable other substances have been used, without judgment or reason, as, for instance, the following, taken from the patent records: parched ground coffee, extract of logwood, blood meal and salt; all thoroughly mixed with water. The two illustrations shown and for the purpose set forth.

"From the chemical standpoint, the most efficient compounds are tri-sodium phosphate and fluoride of sodium. With these, when the water is heated, both the carbonates and sulphates of lime and magnesia are precipitated as phosphates of fluorides, which do not harden on the tubes and shell. The principal objection, however, is the cost of using them in quantities sufficient to remove enough of the scale-forming matter to be of benefit. They are expensive, first, because the chemical equivalent of these compounds make it necessary to use one pound of tri-sodium phosphates to precipitate 9-10 of a pound of carbonate of lime, or .77 of carbonate of magnesia. One pound of fluoride of sodium is required to precipitate 1.19 pounds of lime carbonates or 1.6 pounds of lime sulphates."

Purification

If substances can be found which precipitate boiler scale, there are many reasons why these substances should be used before the water enters the boiler. At times scale in a boiler tube is well broken up, but before this is removed from the tube, it becomes hardened once more and more objectionable than if the compound had

never been used. Boiler compounds can be used to advantage, but there are many instances where independent water softening devices are more satisfactory.

The purification plant shown in the American Wool and Cotton Reporter for April 6 illustrated one type of the intermittent water softening system. It contained two settling tanks provided with mechanical stirring devices. These thoroughly mix the lime and soda with the water in one tank, after which the water is allowed to settle, while that in the other is being treated or used. The plant illustrated also contains a filter tank through which all of the water was drawn.

The Continuous System

There is another method for softening water known as the continuous system. With this attachment, lime is fed into the water as a saturated solution. The amount of lime introduced depends upon the flow of water from the system and the amount of impurities which are to be removed. As soon as the lime treatment is completed, soda ash is introduced in definitely determined quantities. The water then has an opportunity for settling and clearing and is finally passed through a filter for the removing of light floating matter. This system is especially adapted for use where the quantity of water required is uniform; where the water is uniform in character; where the available floor space is limited; where it is impossible to obtain sufficient water quickly enough for the intermittent system, or where extremely large quantities are required.

Intermittent System

Some of the advantages of the intermittent system have been summarized as follows: "First. The absence of automatic chemical feeds. Second. It can be operated by the engineer or his assistant without interfering with their regular work. Third. A constant quantity of raw water is collected to be treated with a uniform amount of chemical reagents. An excess or insufficiency of chemicals is avoided, and, therefore, a uniform character of the purified water is furnished. The simplicity of the apparatus enables an unskilled workman to obtain good results. Fourth. The chemical stirring results in the agitation of the raw water with the chemicals and thus insures an intimate mixture and very materially hastens and soon completes the chemical reaction. Fifth. The sludge of previous purification, which has settled to the bottom of the tanks, is mixed with the water by the action of the mechanical stirring devices. This insoluble matter moving in the water gathers together with the new finely divided precipitate of lime and magnesia, aids chemical reaction and assists the chemicals in clarifying the water.

"Sixth. The sludge collected in the settling tanks relieves the filter bed so that the filter can be run from five to six times as long without cleaning, as would be the case were the sludge all intercepted by the filters. Seventh. Inasmuch as the settling tanks do not usually require washing or emptying oftener than once a week, the amount of wash water required is a very small percentage of the total amount purified. Eighth. The water can stand for some time in order to get complete chemical reaction between the soluble impurities of the water and the chemicals added. Every chemist understands that no chemical reaction is instantaneous. If the lime and magnesia are not completely removed in the purifying apparatus, they are sure to precipitate in the piping, heaters and boilers. Ninth. The perfect quiet of the water gives an opportunity for complete settling. Tenth. The arrangement of the two settling tanks permits an accurate daily record to be kept of the amount of water evaporated in the boilers. This feature will be appreciated by careful managers of large steam plants who have a regard for a coal pile."

Requirements for each individual textile mill should receive special attention; apparatus admirably suited for one is in no way applicable for others. All engineers of textile mills are more or less familar with the scale-producing qualities of their feed water. The prevention of this scale should receive careful study and systematic regulation. If boiler compounds give good results, they should be used in definite quantities, and not in large amounts one week and the opposite the next. If scale trouble is not eliminated by the methods in use, some other arrangements should be made.

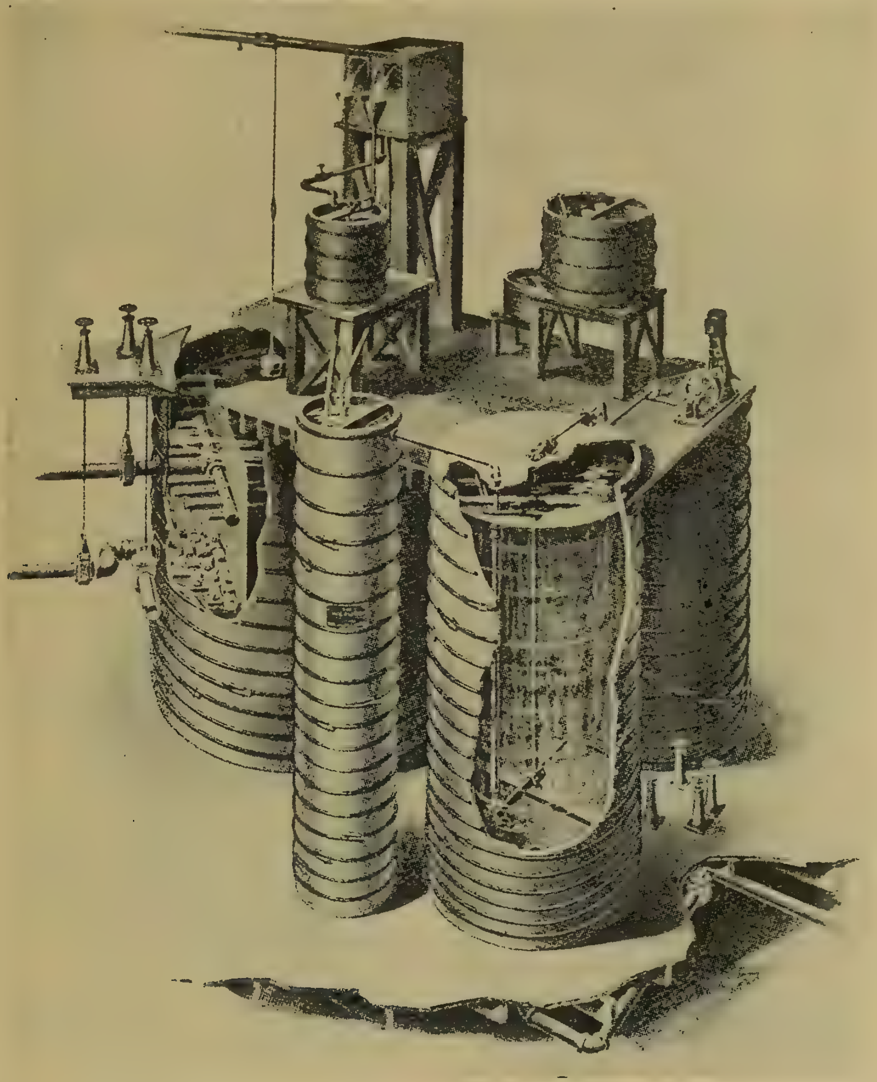


Fig. 82. A Four-Tank Water Purification System.

Special Requirements

Better Lubrication

Engine rooms containing modern equipment are generally provided with continuous oiling devices, instead of depending upon the engineer to fill the many oil cups by hand. These systems are not provided simply to lessen the engineer's work, although this item in itself is of importance. The main

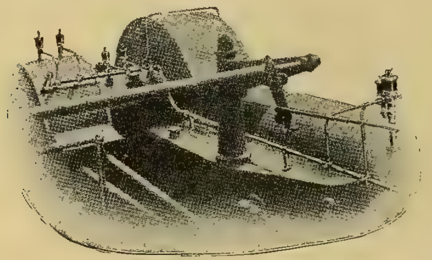


Fig. 116. Oil Circulation Piping on Reciprocating Engine.

value of a continuous oiling arrangement is that less oil is required and better lubrication obtained with the modern forms of supplying oil to the various engine bearings in a continuous stream. Each journal receives considerably more oil than would be used with hand feed. The excess is not wasted, but runs off into drip pans; is later filtered and pumped back to the supply tank. With this system the bearings are completely flushed with oil at all times, yet in no other way is it possible to accomplish proper lubrication with the consumption of so little oil.

Oil Wasted

Consider for a moment the method employed when filling the oil cups by hand. The engineer keeps a small can of oil for filling these cups. As each one is filled, a certain amount of oil drips from the can onto the engine. In almost every instance, the engineer will carry a piece of cotton waste, and wipe this oil from the can and oil cup. In many instances a certain amount will be spilled upon the engine frame and this likewise wiped off with the waste. A careless engineer will throw away a tremendous amount of oil in this manner, and even the best of engineers cannot fill the oil cup by hand without spilling some. It is possible and practical to use extractors for taking the oil out of the old, oily waste. These are used at many plants and may introduce a considerable saving. There is no excuse, however, for having such large quantities of oily waste, for by installing a simple system, which will keep the engine bearings lubricated automatically, no oil will be spilled. There are few who realize the added expense that this needless waste of oil introduces.

William M. Davis, in a paper on "Economical Lubrication," read last year before the National Association of Cotton Manufacturers, included the following interesting statements: "Another cause for loss often occurs from wiping up with waste. The oily waste then goes to the boiler room to be burned. In wiping up around engines, it has been found by experiment that a pound of dry waste will, after being used and squeezed out by hand, weigh two pounds, or, as the writer found at one plant, there was a loss of one gallon of oil for every ten pounds of dry waste used.

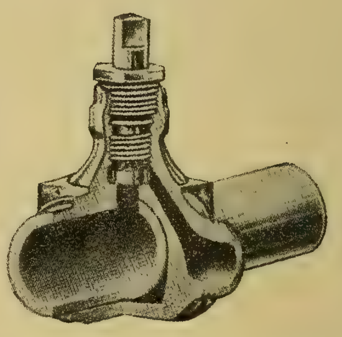


Fig. 117. Oil Header Fitting for Branch Pipe.

"To give an idea of what this loss sometimes amounts to, the writer, while inspecting lubricating conditions at a mill, found on inquiry that they were using waste at the rate of 28,000 pounds per year. Most of this waste was used for wiping up around the engines and machinery on which a great deal of oil was used. All of it was sent to the boiler room to be burned. As the waste was heavy with

oil. It is safe to say that, at the very least, 2,000 gallons of oil were lost per annum."

With an oil circulation system, it is of vital importance that all the oil not used up in the bearings be properly cleaned and returned to the supply tank. There have been many gravity oil feeds attached to engines where only part of the oil has been saved, and

Simple but Efficient System

Fig. 118. One Section of Oil Filter, Illustrating the Large Filtering Surface.

where even this part has not been well filtered. Installations of this nature are sometimes just as good as the old hand methods, but as a rule, they are more wasteful of oil. Systems which are properly designed save almost every drop of oil that is not actually used on the bearings. This is filtered and made perfectly clean, and all sediment which is taken out by the filter can be used as rough, coarse grease for lubricating gears, industrial railway switches and other purposes of a similar nature.

Too many engineers have an idea that any old arrangement containing an oil tank and a pump for forcing the oil drips back to this tank will work as satisfactorily as one designed with special care by manufacturers who have given this line of work years of study. They go ahead and install some sort of a system, according to their own ideas, and get results varying according to their own personality and information.

Instead of using elbows and tees, one typical drip system is composed of bent conduits and junction boxes. With this arrangement every part of the system can be cleaned with a wire while in service. Drip manifolds are provided with a screw top. These manifolds are heavy enough to permit tapping on all sides, and two or more pipes may be connected at the same side, if necessary. The top cap of the manifold is easily accessible, and the entire system may be readily cleaned. Figure 116 indicates the way in which the conduit is carried to the various oil cups of the engine. An oil header runs along the frame, as shown, and branch pipes lead out to the various feed cups. A header stop valve is connected with each branch, so that it may be shut off or removed at any time. The main header has an oil throttle placed near the steam valve, and a blow-off connection at the extreme end of the header. The blow-off discharges into an oil guard, so that oil blown out is not wasted, but is carried to the filter. Figure 117 illustrates one of the oil header fittings cut away to show the inside construc-

Bent Conduit

tion. This fitting makes a straight oil line, and avoids pockets or screw joints. Each system must be designed to meet the special requirements, but the general idea of distributing the oil through a system without any sharp bends is well illustrated by Figures 116 and 117.

The Filter

With proper filters there is seldom an opportunity for the distributing system to become clogged, but the benefits derived from using a system which can be easily cleaned will be appreciated by all engineers. In determining the

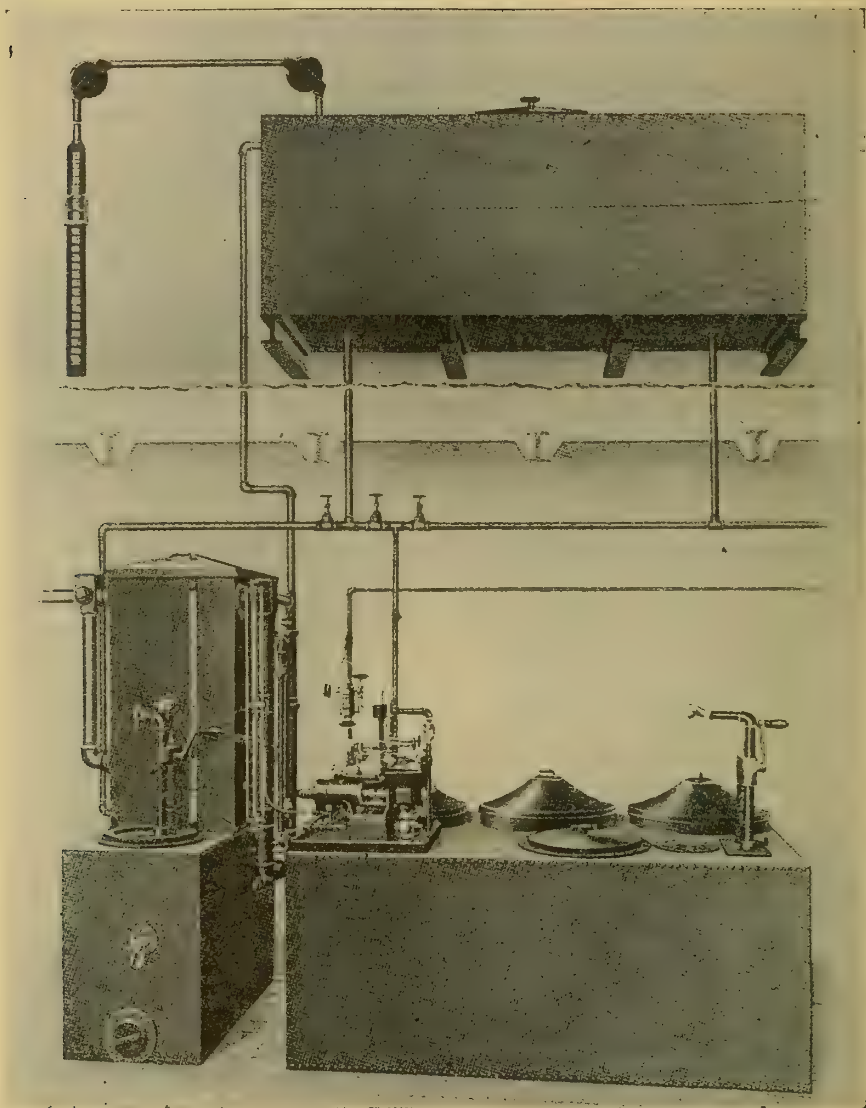


Fig. 119. Tanks, Filters, Pump, etc., for an Oil Filtration and Circulation System.

proper type of filter to install, the number of square feet of filtering surface should be definitely determined. In addition to this, accurate data obtained from tests where similar apparatus is installed should be studied and investigated. Manufacturers of all types of oil filters will gladly refer prospective customers to mills where their apparatus is in use, and in this way the best kind of data can be ascertained.

Figure 118 illustrates one type of filter which has given good satisfaction in many power plants. The illustration shows the inside construction of the filter and gives a good idea of its construction. It is a closed type, and no leakage can take place except through the muslin. When the filter section is removed for cleaning the dirt is removed with it, and on account of providing a large filtering surface frequent cleanings are unnecessary.

One type of oil filtration and circulating system is illustrated by Figure 119. The system of pipes conveying oil to the engine bearings is omitted from the illustration. The overhead tank and indicator for showing the oil level are at the top of the illustration, while the circulating pump, filter and self-measuring supply pumps are illustrated in the lower half of the figure. The pipes connecting the overhead tank with the other apparatus are shown broken off, as there is no necessity of these being directly over each other.

All Oil Saved

Almost every textile mill has one or more oil storage tanks, as it has been found unwise to keep oil for long periods in ordinary barrels. To be sure, there are some concerns which have not yet appreciated this point, but the number which have remained in ignorance of the savings which could be introduced by installing simple methods of circulating oils to the various engine bearings is much larger. A good automatic oiling system furnishes stream feed to the bearings, permits the re-use of all oil, automatically collects the drips, filters them, and returns the pure, clean oil to the supply tank. Waste is reduced to a minimum as friction losses are reduced by the provision of best possible lubrication. This comes back directly to the coal pile, and reduces the coal bill as well as the oil bill.

A Mistake

Some textile mill managers have the idea that an oil circulation system is simply a device for lessening the work of the engineer. They claim that their engineer has time enough to oil the engines by hand, and give the old excuse against automatic arrangements, namely, that everything automatic is liable to get out of order and fail to operate. There is far less danger of these automatic systems failing to work than there is for the average engineer to forget his oil cups.

Mill Machinery

The power plant is but one part of the textile mill requiring large quantities of lubricating oil. Textile machinery should be well lubricated, and it is possible to waste an enormous amount of machine oil in each department. If oil is kept in one central supply room, and is delivered to the different departments without being measured, it is very frequently wasted by those oiling the machines. If, however, an accurate account is kept of the amount furnished to each of these departments, this acts as a check, and makes those using the oil more careful. By using modern storage tanks, it is an easy matter to know exactly the amount of oil delivered to each department. The tanks have a measuring apparatus. A dial is provided, so that by setting the lever at one point, for instance, each turn of the pumping handle delivers one pint. This dial can be quickly turned, so that any desired quantities can be delivered. In this way, no time is lost in measuring the oil, and at the same time a much more accurate measurement is obtained than by the use of any ordinary method.

It is also possible to have storage tanks placed at any part of the mill, where they can be conveniently filled, and the delivery pumps and measuring apparatus in any mill room. Some of our textile mills are equipped with very complete systems for distributing oil to the different departments. Requirements of this kind vary in different plants. Some mills are very desirous of distributing all oil from one central supply room; other plants wish to have pipes arranged so that each overseer of a department can obtain his own oil supply directly. This question is worth investigation, and well worthy of more attention from those in charge of textile mills.

Delivery System

All textile machinery should be kept well lubricated, and there are so many grades of oil marketed at the present time that it is somewhat difficult to decide which kind is the most economical in the long run. Some mills buy the most expensive oils, and instruct operatives very definitely that this oil must be used with care. This no doubt would be the most advantageous method, if the ordinary operative could be relied upon to supply enough oil to the bearings without wasting it. As a matter of fact, operatives who are called to account for wasting small amounts of oil will go to the other extreme and slight the machinery. It is not difficult to properly lubricate all machinery bearings without wasting much oil, but it has been proven time and time again that mill operatives rebel against repeated caution about the use of oil, and in many instances, machinery has been badly damaged as a result.

Machinery Slighted

There seems to be a tendency among mill help to allow a certain amount of oil to run from the oil can onto the floor before filling any oil holes. No excuse can be offered for this, but the fact remains true. There is also a tendency to enlarge the openings of oil cans, so that the oil may flow more freely. This causes additional waste.

The Human Element

It therefore becomes questionable whether it is true economy to lay too much stress upon the necessity of using oil sparingly. In several instances it has been found more satisfactory in the end to purchase a somewhat cheaper oil and allow the help to use this quite freely. Care should be taken that this does not go to the extreme, and a good overseer can readily prevent it. The best overseers, however, have found it impossible to make the ordinary help use the high-grade oils as sparingly as they should without causing certain machines to be neglected. We do not advise using an extremely cheap oil, but it has been found that a medium grade will oftentimes give good results and cost less money per year.

The value of storage tanks provided with some type of self-measuring pump has been proven great in many instances. The feeling among overseers that an accurate record is being kept of their supplies makes them unconsciously more careful, and the elimination of waste caused by the overflowing measuring cans amounts to a much larger sum at the end of the year than would be expected. The choice of economical grades of oil and the method of distributing these lubricants to mill departments is one of the comparatively small points which may add to the cost of production. The larger textile mills have given this subject considerable attention, but many of these have studied into this matter too little, and the smaller mills have steadily neglected the possible advantages. All unnecessary friction means an unnecessary expenditure of money for power.

Storage Tanks

Another detail which should receive more attention is the care of belting. Several articles have appeared in the recent issues of the American Wool and Cotton Reporter referring to this question. In some establishments, the care

Belting

of belting is entrusted to so many different parties that no one can be held responsible for actual conditions. This method is a mistake, for there should be some one man responsible for every belt in the mill. In even medium sized plants, this man must, of course, have assistants, but their reports to him must be explicit enough so that he can be held responsible in all instances.

The evil effects of allowing belts to be stretched too tightly have received considerable comment. This is an important item, however, and much power is being thrown away daily on this account. Tight belts often injure hanger bearings and introduce excessive line shaft friction, which remains even though the belt be subsequently loosened.

Needless Neglect

In all departments where any amount of lint is present, belts should be frequently cleaned. The lint was removed from a belt which had been run several months without cleaning, and it was found that the speed of the driven shaft was noticeably increased. The dust had formed a coating upon the inside of the belt and had allowed an abnormal slippage to take place.

The introduction of electric motors for driving textile machinery has reduced the number of large driving belts, but the majority of electrically operated plants still use a large number of smaller belts for operating counter shafts, driving machinery in groups. Once all these belts have been put in good condition, it is not an expensive matter to keep them so. It is an expensive matter to neglect them.

The Steam Plant

Steam boilers for even a medium sized textile mill represent a considerable investment. The vital parts of these boilers are out of sight. There are no working parts which prevent the boilers being used, even after they have been badly neglected, and this abuse is often allowed to continue, regardless of the additional expense incurred. Fire tube boilers, as their name implies, contain tubes through which the products of combustion pass. With this type, the outside of the tubes is in contact with the water, and constitutes the heating surface. Stationary fire tube boilers are manufactured with horizontal tubes, and also with tubes in a vertical position. The former type is commonly known as horizontal tubulars, and the latter frequently designated as vertical boilers. Both of these are comparatively cheap in first cost, and both are in use in hundreds of textile mills. For boiler rooms, where the floor space is limited, the vertical type can be installed advantageously, and when properly designed, may give good economy. These boilers have a cylindrical shell, with a fire box in the lower end, and with fire tubes running from the furnace to the top of the boiler.

Horizontal Tubulars

The horizontal tubulars consist essentially of a cylindrical shell closed at the ends by two flat plates. The fire tubes are expanded into each of the tube plates, and about two-thirds of the bottom of the boiler is filled with water, while the other one-third is reserved for steam. The products of combustion pass back over a bridge wall to the back end, and then forward through the tubes, and up to the up-take, into the flue that leads to the chimney. For low pressure steam, these boilers are very satisfactory, and latest types are designed so that steam pressures suitable for operating steam turbines may be carried comparatively little. These boilers contain a large body of water, and the entire shell is under high pressure. If there is any failure, either through some defect or through carelessness of attendants, the explosion which takes place is disastrous. When properly designed, and subsequently cared for by competent and careful attendants, they are safe and durable. The large mass of hot water tends to keep a steady pressure but prevents raising the steam quickly to meet sudden demands for more steam.

Water tube boilers have the water inside of the tubes, and are designed so that the products of combustion pass over the outside surfaces. There is a separate drum or reservoir for storing the steam, and in this drum the steam is separated from the water. This drum is kept away from the fire, or is reached only by gases that have already passed over the surfaces of the water tubes. The tubes are of small diameter, and can be amply strong, even when made of thin metal. If one of the tubes should fail, the damage done is comparatively slight compared with the failure of the fire tube boiler.

Water Tubes

Each type of boiler has its advocates, and both fire tube and water tube units may give good satisfaction if properly managed. Boiler inspections are made with much more thoroughness than was the case a few years ago, but even the most careful scrutiny often fails to show up a weak joint or other defect, which may lead to an explosion. Holes are left in horizontal boilers, so that an inspector can get inside and look over all tubes and stay-bolts with care, but it is frequently found that defects cannot be discovered when the boiler is cool enough to allow inside inspection. Reliable boiler makers are now manufacturing equipment which has reduced greatly the number of boiler accidents.

The efficiency of any boiler depends largely upon the cleanliness of the heating surface. This heating surface must transmit heat from the hot furnace gases to the water. The transmission is rapid through the metal tubes, but any accumulation of scale or soot obstructs the flow of heat much more than is frequently believed. The amount of this loss, due to the accumulation of soot and scale, varies according to the type of boiler, the kind of fuel burned, the amount of draft available, and the load under which the boiler is operated. There have been many tests made to determine the loss of heat caused by layers of foreign matter, but there are so many details that enter into this result that scarcely any two authorities agree exactly on this point. One recognized authority states that soot has more than five times the resistance to heat as does fine asbestos. Even allowing this to be an exaggeration, all tests show plainly that thin layers of soot cut down the boiler's efficiency.

Cleanliness

Few engineers ignore this fact entirely, but many of them give it too little consideration. Some engineers doubtless realize that their tubes are in poor condition, but either through lack of aggressiveness on their part or unwillingness on the part of those in charge of the power plant, do not remedy the evil.

Removing Soot

The perfection of feed water heaters has done much to keep hard scale-forming material out of the boilers, and it is but natural that many who realize the injurious effects of hard encrusted scale fail to recognize the waste caused by thin layers of soot.

It is estimated that the loss of conductivity of boiler plate, due to different thicknesses of soot deposit, is approximately as follows: 1-32 of an inch, 9.5 per cent; 1-16 of an inch, 26.2 per cent; ⅛ of an inch, 45.2 per cent; 3-16 of an inch, 69 per cent.

Whether fire tube boilers or water tube units are used, the necessity of cleaning off soot still remains. With the fire tube boiler the soot collects inside the tubes, while with the water tube type, the deposit remains upon the outside surfaces. The frequency with which these should be cleaned depends upon many conditions, but the cleanings should take place often enough so that there may never be more than 1-32 of an inch deposit. If cleanings can be conveniently made so that this deposit will be kept below 1-32 of an inch, the boiler efficiency will, of course, be correspondingly increased.

By opening the door in front of the tubes of a horizontal tubular boiler, it is possible to blow the soot out of

each tube by use of a jet of steam. Special nozzles have been designed for accomplishing this, and they have made it possible to remove soot fairly satisfactorily, while the boilers are hot. As already noted, the products of combustion pass from the rear of the boiler toward the front, therefore the jet that is blowing the soot from the front is working in the opposite direction to the natural draft.

Tube Cleaning Attachment

Figure 126 illustrates a tube cleaning attachment, which is set permanently in the rear wall of each horizontal boiler. It consists of a specially designed steam nozzle, which may be rotated from the outside, so that the steam jet can be passed through each one of the fire tubes. With this attachment, the work of cleaning soot from the tubes is greatly decreased. It is objectionable work to blow the tubes out from the front, but with the contrivance illustrated by Figure 126, this work can be done effectively and quickly. A pointer is provided, as shown by the illustration, which indicates the steam direction.

Operation

To clean a set of tubes with this apparatus, the indicator on the dial is placed opposite the first division, as shown in Figure 126, and the steam jet is then directed upon the outside tubes. Moving the indicator around the dial changes the steam direction, so that when it rests in the last notch, the steam is delivered directly in the centre tubes. This pointer shown in the illustration changes with the indicator, so that the operator always knows which tubes he is cleaning. The mechanism is simple, can be easily installed, and modifications of that shown by Figure 126 can be obtained suitable for all kinds of boilers which are used in textile mills.

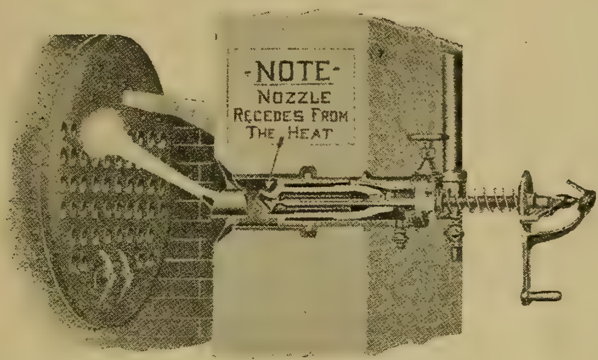


Fig. 126. Removing So ot from Boiler Tubes.

Practical Test

The power plant of the Wood Worsted Mill, of Lawrence, Mass., contains 42 horizontal tubular boilers, and behind each one a mechanism similar to that shown by Figure 126 is provided. With this apparatus it has been possible to keep the boiler tubes in unusually good condition, and evaporative tests made upon the boiler plant show a decided gain in efficiency. It is much easier to clean tubes with the apparatus illustrated than with long nozzles, which must be applied at the front with the boiler front open. This means

that tubes can be cleaned more frequently with the same amount of labor. Keeping the boiler front open causes a loss in steam pressure, and consequently, additional fuel must be supplied to regain this pressure. With the cleaning attachment connected behind each boiler, the cleaning is carried on without opening the boiler front.

Mill Construction

Why can some mill owners erect new buildings for less money than others located within the same city or town? Special commercial relations doubtless enable some to purchase materials at rock bottom prices, but leaving this class entirely out of the question, there still remain men who are able to put up new buildings more economically than their neighbors.

We shall not attempt to give all of the reasons for this fact. We shall, however, consider a few of the types of contracts under which mill buildings are generally erected, as the choice of the contract affects materially the final cost of a new plant. The contract which at first seems the one most desirable, is frequently unnecessarily expensive before the work in question becomes completed. Some contractors advise a certain form of contract, simply because they know it will mean more money for them on the one piece of work under consideration, while others recommend the one most advantageous for both parties, realizing that there will be more work in the future which will probably be given to the fair and square contractor.

Placing Contracts

In justice to the contractor, it must be said that some mill men are not willing to look at the question fairly, but are determined to give work to the contractor submitting the lowest initial estimate, regardless of the probable expense for extra work which is sure to arise. This type of owner may once in a while get work done cheaper than the man who considers both sides of the questions fairly, but, as a rule, he is the loser.

The method of contracting, which is perhaps the most common of all, is known as the "lump-sum" system. Under this arrangement, the contractor agrees to furnish all labor and material necessary to complete a certain definite piece of work for a definite lump sum. Plans and specifications must be complete at the outset in order that the contractor may know definitely just what work is to be performed.

"Extra Work"

It is almost impossible to make plans for work of any considerable importance which will not need more or less changing as the work proceeds. Again, the owners are almost sure to change their minds about several details, and this introduces still further deviation from the original plans. This may seem an unimportant matter, but it is not. Changes, even though they be slight, bring in the all-too-familiar term "extra work." If the contractor has figured too low on the work, the "extra work" account is his chance to turn loss into profit. If there has been a time limit clause in the original contract, the "extra work" provides for an extension of time.

Can we blame the contractor? He is in business to make money and the mill man knows this. Now if in trying to land the contract, the estimated cost has been figured too low, can we blame the contractor if he arranges the "extra work" account so that the work will bring in a fair profit? Perhaps not; but will this account bring the contractor more than a fair profit, and if it does, how can the owner prevent it?

Opposed Interests

With this form of contract, the interests of the owner are opposed to those of the contractor from start to finish. Every cent which the contractor can save goes into his own pocket, while all of the money that the owner

pays does not necessarily represent value received. The owner may be paying non-competitive prices for extra work and he may also be paying a large item for interest on his investment and loss of production, because the work is not progressing any faster than is most economical for the contractor.

Any labor-saving device which introduces a saving in time benefits the contractor and not the owner, for if extra work has been ordered, and, as is almost always necessary, the time limit is extended, the contractor can take advantage of the labor-saving device by employing less men instead of using the same number of men a shorter time. If cement can be saved, and still keep the concrete work up to the standard called for in the specifications, the saving goes to the contractor and not the owner. If savings are introduced which do not keep the work up to the standard called for, the entire amount saved also goes to the contractor. There are many instances, with this kind of a contract, where this can be done, but we shall not at this time discuss the conditions which may be introduced by dishonest contractors. We wish rather to call attention to the necessary relations between owners and contractors under various types of contracts.

Best Workmanship

The owner wishes to erect his mill for the lowest possible total expenditure but also wants the best workmanship. Again, in all probability, he wishes the work completed at the earliest possible moment. The contractor wishes to make as large a profit on the work as he can, but he also wants to please and satisfy the owner sufficiently to bring future work in his direction. It has already been stated that with the "lump-sum" contract, the interests of the owner and contractor are opposed from the very start. With this condition, it is difficult for them to agree sufficiently to encourage further transactions in the future. We do not say that they cannot do this, but that it is difficult.

"Lump-Sum" Contracts

The owner does not necessarily get the work done for the lowest cost, for he has agreed to pay a stated sum as soon as certain definite work is completed in a manner which he and the architect cannot refuse to accept. Whether he obtains the best workmanship depends upon the contractor, and the amount of inspection provided and payed for by the owner. The work will not in all probability be completed in the shortest possible period of time, for time extensions are allowed on account of extra work, and the contractor will probably do the work at the speed most economical for him.

The contractor who accepts work under a "lump-sum" contract is taking the risk of meeting unfavorable circumstances. For example, he may find that under one part of the new textile mill, several hundred piles must be driven for which he has made no allowance in his estimate. Sometimes these unexpected conditions cause the contractors to actually lose money on a piece of work, but they are not in business to lose money, and are obliged to add a certain percentage to their estimated cost for protection against unfavorable circumstances.

Additional Cost

The owner has to pay this additional percentage whether the undesirable conditions are found or not. If they are found, it is, of course, right that the owner should stand the expense. If they are not found, the contractor still receives the money. It is as possible for the contractor to meet with fortunate circumstances as unfortunate. In this case, the owner is paying the ordinary amount plus the added percentage for risk, while the actual cost is below normal.

"Percentage" Contracts

The "percentage" contract is frequently used by mill owners to overcome the undesirable features of the method just described. Under this latter form, the contractor agrees to furnish all labor and materials needed to complete the work to the satisfaction of the owner and architect for cost plus an agreed upon percentage of the cost. Under this arrangement, the "extra work" item is eliminated and the contractor, as well as the owner, wishes to complete the work as soon as possible. The interests of the two parties are much more in common, causing less chance for disagreements, which so often make construction work drag along over extended periods of time.

With the percentage contract, any inexperienced work is paid for by the owner, so that the contractor is not running any risk and, therefore, has no excuse for adding on an additional protection price, as with the lump-sum arrangement. If certain materials like cement can be used more economically than is the ordinary practice, the owner receives the saving. If the contractor introduces a labor-saving device, whereby work can be performed more quickly and economically, the owner is benefited by a reduced cost, and both are benefited by a decrease in the time required to complete the building. As previously mentioned, mistakes made by contractors under "lump-sum" contracts sometimes make it possible for owners to get work done for less than cost. This cannot happen with the percentage contract, but as it seldom happens under any contract the point is not of great importance.

Objection

Mill men sometimes object to the percentage contract. They claim that as the price received by the contractor increases in direct proportion with the total cost of the work, the contractor finds it to his advantage to make the cost as great as possible. It is true that the greater the cost the greater the contractor's profits. Without doubt, contractors who are doing their best to give satisfactory results are sometimes accused unfairly of "boosting" the cost. However this may be, here is one important point upon which the interests of the owner and contractor are at variance. The owner wishes the cost kept down, while an increase in the cost means an increase in profit for the contractor.

The Remedy

To overcome the objection referred to without removing any of the advantages of the percentage contract, another form, known as the "cost-plus-a-fixed sum" contract, has been employed. Under this method of contracting the owner agrees to pay the cost and also a stated amount which is to be the contractor's profit. With this arrangement there is no inducement for a contractor to increase the cost unnecessarily, for he receives a certain stated amount of money regardless of the final cost of the work.

The owner's and contractor's interests become similar under this last type of agreement. The "extra work" item is excluded; the contractor is not charging an extra amount of money to protect himself against a possible risk of unexpected work; and it is to the advantage of both owner and contractor to complete operations as quickly as possible. The owner can decide just what grades of stock shall be used, can receive the benefit of all cash discounts, and knows at the outset just what the contractor's profit is to be. The owner's interests call for the work to be performed in the shortest possible time at the lowest possible cost and with the best of workmanship. The contractor's profit, or salary, is assured, and it is, therefore, to his advantage to perform the work in a manner which will cause "repeat orders."

Plans may be changed at any time without delaying the work to any

great extent, and the excavations and foundations may be completed while the details concerning the superstructure are being decided upon and the plans drawn accordingly.

Delay Prevented

The "cost-plus-a-fixed-sum" contract makes it possible for the owner's engineer to command the contractor to put on non-union men in times of strikes, and gives him the right to use whatever means he may wish to obtain quick delivery of materials. In short, the owner's engineer can have the entire work performed in any way desired. While the work is in progress, the contractor becomes practically an employe under the management of the owner. His salary, or profit, being decided upon at the start, his aim is to give satisfactory results.

Textile mills in England from 1825 to 1865 were constructed with wooden floors, supported on transverse wooden beams, crossed by longitudinal joints, on which two layers of floor boards were fixed. The ceiling was plastered on laths fastened to the joints, and the whole floor became a hollow inflammable structure.

In England

In writing of the early cotton mills of England, Joseph Nasmith states: "Just before the year 1870, joint-stock spinning companies were started, stimulated by the establishment of the Sun Mill, Oldham, in 1868. The great success which attended this venture led to its wide imitation, and for a few years, mills in Lancashire, and especially in Oldham, increased with great rapidity. Gradually they became larger in size, and a call was made on the machinists to provide machines of great dimensions. In 1874, the ring spinning frame was beginning to make its influence felt, and, owing to the large production possible by reason of the great speeds at which the spindles could be run the necessity for higher velocities of mules became apparent. Both machines required more careful construction, and dating from the introduction of the ring frame, a complete change has come over constructive methods. The economic rivalry of the various limited companies speedily led to the more complete organization of their forces. It was found possible to manage mills containing many thousands of spindles in excess of those previously common with the same staff, and mills were accordingly designed with this factor in full view.

"Gradually, the lengths of the machines increased and the mill was, of necessity, correspondingly enlarged. As a sequence to this came a consideration of providing light, so that a room 130 feet wide should not suffer in that respect. Gradually, the ceilings became loftier and the window area of greater importance."

Mills Enlarged

Mr. Nasmith points out that since 1870 there have been three important factors at work. They are:

"1. The increased competition, arising from economic causes, tending to the enlargement of the machines so as to correspond to the limit of the operative's capacity.

"2. The improvements in the constructive methods of machinists, resulting in the production of machines capable of running with steadiness at high velocities.

"3. The provision of building materials which lend themselves to the construction of mills of large size."

These same three factors have been and still are at work in the United States. Although the number of working hours has been constantly decreased, the amount of work turned out each day by one operative is greater than it has ever been in the past. Improvements in the textile machinery are responsible in a large way for these changes, but the improvements in mill construction and in general mill equipment are also of vital importance.

More Efficient

Large window areas have already

been mentioned. It is important to furnish operatives with as even and uniform illumination as possible. Large window areas admit increased quantities of cold air during the winter, and the extra task upon the heating system has had to be considered. Floor beams will keep out light and cause shadows unless they are properly designed. This question is receiving much attention at present.

A mill built in England as early as 1834 was claimed to be fireproof. Tee-shaped cast-iron beams were placed transversely of the mill and were supported near the middle by cast-iron pillars. From the transverse beams brick arches were sprung. Upon them the floor was laid and was constructed of timber.

In America

In the United States, special forms of fire-resisting structures have been tried, but most of the mills have been built with the aim to provide a building which, although not fireproof, is not easily burned. For many years the standard slow-burning type of mill construction has been common. Many arrangements are included under the general name "standard mill construction" and while to outside appearances mills built at varying intervals have closely resembled each other, there have been many differences in improved detail. Our oldest textile mills were usually built of stone and had slanting roofs.

Mill Roofs

The slanting roof wastes much room and is undesirable for mill buildings. These roofs of the old mills were combustible, and as nothing was known of modern fire protection apparatus, it was not infrequent to have serious fire damage. The steep slanting roof costs about the same amount and necessitates the loss of valuable floor space. The floor immediately under the roof can be used to some extent for storage purposes, but the amount of storage space thus provided is small. If this part of the structure is not floored, the slanting beams of the roof offer no ready means of attaching shafting. There are old mills to-day which still have this type of roof, but most of them have been changed and the flat roof substituted. Some early mills which had substantial stone walls were fitted with posts and flooring of light material. This small stock had to be used in large quantities in order to obtain sufficient strength, and this again made the interior of the mill extremely combustible. Cotton is sensitive to fire from causes which would not affect other materials, and in several of the manufacturing processes, there is considerable chance for fires.

Fire Protection

Improvements in construction and fire protection have reduced the fire hazard and have brought the fire cost below that of many other safer kinds of business. Modern lighting devices have also done much to reduce the fire hazard. Kerosene lamps give less trouble than one might expect, but at best an equipment of this kind increased tremendously the danger from fire. It is true that a few mills are to-day using kerosene lamps. It is impossible to conceive any legitimate reason for this. Parties familiar with the plants thus equipped claim that there have been few fires and that the lamps are not dangerous. It may be true that there have been few serious fires, and it is doubtless true that many small fires have never been reported. Mill managers who continue to use kerosene lamps for lighting their mill would probably much prefer to stand small fire losses themselves rather than have the case become public through the insurance company.

Gas Lights

The kerosene lamps cannot sufficiently illuminate a mill room to give best results, but entirely aside from this, they are dangerous and should not be tolerated. After the kerosene lamp came illumination by gas. Gas flames

can be protected so that there will be little danger, but this was seldom done. Open flames were repeatedly allowed in rooms containing inflammation is in itself a broad one, and there are many different arrangements which are satisfactory, but this time we will not discuss the merits

Fig. 78. Steel Towers and Car Used for Handling Concrete.

mable substances and expensive fire losses were the result. All modern mills are to-day illuminated by electricity. The subject of electric illu- of the various systems. Most textile mills are to-day equipped with some kind of electric lights. Improvements in electric generators and light-

ing devices have reduced the cost of these installations and simplified the layout. Mills driven by water power have been able to install lighting generators and develop electricity at a low cost. Mills using steam power have likewise been able to install lighting generators, and while power may cost them slightly more than the water-driven units, the electric lighting system is still an economical one.

Wood Frames

The fact that old mills frequently had substantial stone walls should not allow us to forget that many plants were wooden structures. These were formerly built of light framing, and this formed excellent material for destructive conflagrations. The use of light floor beams was later discontinued and heavy ones less in number were introduced. These heavy beams are combustible, but fire can not get beyond control so quickly as with the many small ones. From this fact originated the name slow-burning mill construction. It was a type of construction which would burn, but fire could generally be extinguished before any large amount of damage was done. The automatic sprinkler head has now become a common part of the mills equipment. To-day, insurance companies are strict in demanding an equipment of automatic sprinklers and they have definite rules regarding the location and spacing of these heads.

Automatic Sprinklers

Much attention nas been given to the smallest details of mill construction, both by mill engineers and by insurance companies. The mill engineer must of necessity consider stability, strength of materials and fire protection. The insurance companies have laid special stress upon the fire protection end, but in order to make their regulations feasible and uniform, the other points have also received consideration. The requirements for sprinkler equipment, as made out by the National Board of Fire Underwriters, give the proper spacing for sprinklers as follows:

"Under mill ceilings (smooth, solid plank and timber construction six to twelve feet bays) one line of sprinklers should be placed in the centre of each bay, and the distance between the sprinklers on each line shall not exceed the following: Eight feet in 12-foot bays, 9 feet in 11-foot bays, 10 feet in 10-foot bays, 11 feet in 9-foot bays and 12 feet in 6 to 8 foot bays. The measurements are to be taken from centre to centre of timbers."

Under joisted ceilings, open finished, the distance between the sprinkler heads should not exceed 8 feet with right angles at joints or 10 feet parallel with joints.

Where sprinklers are placed under smoothed, sheathed or plastered ceilings in bays 6 to 12 feet wide (measurement to be taken from centre to centre of timber, girder or other projection or support forming the bay), one line of sprinklers should be placed in the centre of each bay, and the distance between the heads on each line should not exceed the following: Eight feet in 12-foot bays, 9 feet in 11-foot bays and 10 feet in 6 to 10-foot bays.

Bays in excess of 12 feet width and less than 23 feet in width should contain at least two lines of sprinklers. Bays 23 feet or over should have lines not over 10 feet apart.

Pipe Sizes

Careful consideration has also been given to the number of sprinkler heads which are allowable with various sizes of piping. The number of sprinkler heads permitted according to the rules of the National Board of Fire Underwriters is as follows: Three-quarter inch pipe, one sprinkler; 1-inch pipe, two sprinklers; 1¼-inch pipe, three sprinklers; 1½-inch pipe, five sprinklers; 2-inch pipe, 10 sprinklers; 2½-inch pipe, 20 sprinklers; 3-inch pipe, 36 sprinklers; 3½-inch pipe, 55 sprinklers; 4-inch pipe,

80 sprinklers; 5-inch pipe, 140 sprinklers, and 6-inch pipe, 200 sprinklers.

The requirements also add, "Where practical, it is desirable to arrange the piping so that the number of sprinklers on a branch line will not exceed eight."

At the time automatic sprinklers were first introduced, mill men would have complained greatly against following out the minute details necessary to obtain proper sprinkler installations. These systems do introduce considerable initial expense, but this is nothing compared with the advantages they introduce. Sprinklers should not only be used, and placed where fires are liable to originate, but they should also be installed at every part of the mill where the fire is liable to spread. One sprinkler head applied immediately to a small blaze frequently saves tremendous loss of property.

Stair Towers

Stairways and elevators should be separated from the main part of the mill by fireproof walls. This practice was carried out considerably in our oldest mills. The oldest mills always contain a tower. It has been thought by some that outside appearance was the only reason for building these mill towers. They were, however, designed to contain the stairways, and the old-time stair tower is still in use. The old mills generally built the stair tower outside of the main mill.

Modern mills are sometimes built with outside towers, but often one end of the building will be cut off by a fireproof wall, and this portion will contain an elevator well and stair tower.

Floor Beams

Improved methods of fire protection have done considerable toward the uniform development of mill construction. The element of cost has its effect, but the mill engineers have generally considered the total cost of keeping a mill in proper repair, rather than initial cost. When large heavy timbers were first used for floor and roof beams, it was customary to use single beams for each support. These large beams frequently contained imperfections and were partially decayed without showing this on the outside. It is, therefore, better to use two smaller beams bolted together. In this way, decayed matter which might be concealed within a large beam is shown up and thrown out when the beams are cut to size.

Excessive vibration of flooring causes textile machinery to become out of adjustment, and a long driving shaft used in many of the machines becomes bent and out of line. Modern construction methods have done much to stiffen the floors. The floor boarding is sometimes laid diagonally to increase this stiffness. Some comparatively new textile mills have used timbers about two by five inches for floor planks, and have placed them on edge. These are covered with the regular top maple flooring, and exceedingly stiff floors have been obtained.

Wood columns have given way in some instances to those of cast iron and wrought iron. Under some conditions, it is advisable to use heavy cast-iron columns. Cast iron cannot be depended upon, however, and its use for columns is often unadvisable. Wrought iron can frequently be used to advantage.

Steel Beams

Structural steel has to some extent replaced the heavy slow-burning wooden floor beams. Steel beams with iron columns and plank floors give a good solid building, but its fireproof qualities are not much better than with the heavy wooden floor beams. A fire which would be serious enough to burn the floor beams would, of course, burn the flooring, and a fire bad enough to burn the flooring will generally warp and twist the steel beams. The newest kind of mill buildings are those of reinforced concrete or a combination of reinforced concrete

and brick. Much can be said in favor of a concrete mill building, and, under many conditions, the increased cost for building such a structure more than balances the advantages.

At the present time, a combination of brick and concrete is perhaps the most popular type. Reinforced concrete for mill buildings will be considered more in detail in our future issues of the American Wool and Cotton Reporter.

Reinforced Concrete

It is impossible to say what effect reinforced concrete may have in the near future. Fireproof mills have recently been built of this material and with lumber constantly growing more expensive the fireproof concrete mill may soon become the common type. It is somewhat more expensive, in most localities, to build a mill of reinforced concrete than to erect one of the standard slow-burning construction. The methods of handling concrete are being constantly improved, and this one point has reduced the building cost considerably.

As a new concrete mill progresses it is a problem to quickly and economically deliver the wet concrete to the upper stories. In building the concrete storehouse at the Massachusetts Cotton Mills, two steel towers were used for elevators, and extra derrick beams were fastened at any desired position. Concrete mixers were set up at the base of these towers. Concrete was raised to the required height and then emptied into industrial cars which were arranged to run to all parts of the particular story under construction.

The steel towers were designed so that they could be quickly erected. When the building was completed, they were taken apart and were ready for use in connection with other contracts. Figure 78 shows the two towers used at Lowell and the car used for conveying concrete for the various parts of the structure.

New Concrete Mill

A new concrete mill building is being erected by a large New England textile mill corporation and when it is completed will give this concern a large amount of additional floor space. This will be a great help in changing over the machinery arrangement in many of the departments, and it is planned to take up this work systematically and thoroughly in the near future. Several of the older buildings have become crowded, and in a good many instances, new equipment has had to be installed in temporary locations, that is, new machinery could not always be placed in the most desirable manner, on account of lack of room, and to rearrange a crowded department without seriously interfering with production is a difficult problem.

This company obtains all of its power by water wheels. Some of these are belted to jack shafts and the power transmitted mechanically, but a good deal of the machinery is now operated by electric motors, the electricity being generated by units direct connected with water turbines. This company requires considerable steam for manufacturing purposes and during the last few years modern recording devices have been installed and in several instances records obtained by these have made it possible to introduce a considerable saving in the amount of coal burned. The power

problem has received much careful study and many decided improvements have been introduced. An old mill used by the company for storage purposes is located at some little distance from the main mill and has power privileges which are utilized, the power being transmitted to the main mill electrically. The old mill is located upon the lower level canal, so that since the installation of the hydro-electric plant, the company has been obtaining water power from both canals.

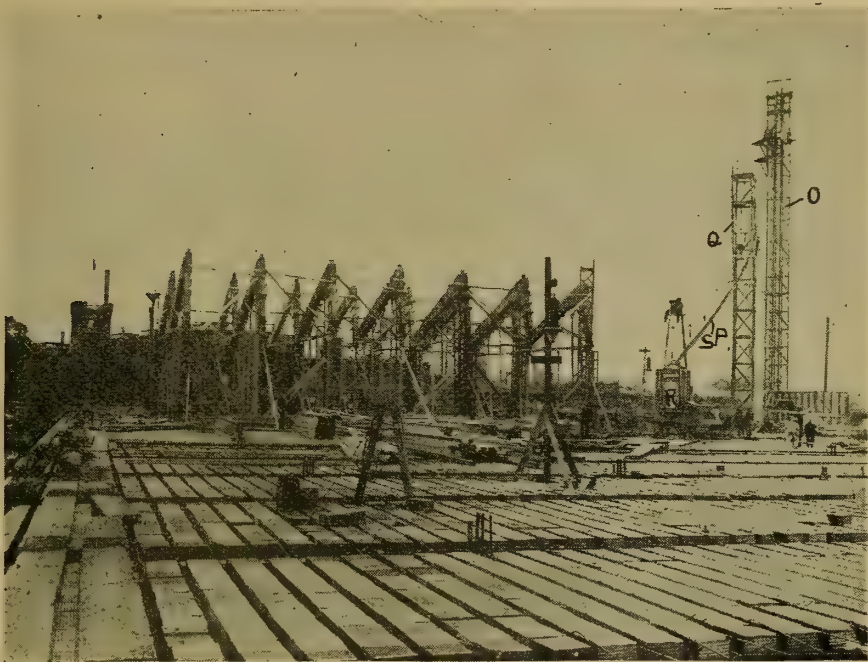


Fig. 164. General View of New Concrete Mill Showing Floor Construction and Roof Frames.

Power Centralized

As soon as the new building is completed, much of the electrical power will be centralized in a new station, and the textile machinery will be moved so that the stock can be handled with a minimum amount of trucking. Some of the advantages brought about by a general alteration of machinery at the Hamilton Manufacturing Company's plant in Lowell was recently commented upon, and some time ago the changes which were made at the Harmony mills, Cohoes, N. Y., were discussed. At the Harmony Mills a large part of the machinery had to be thrown out and new equipment installed, and while a large amount of new machinery was purchased by the Hamilton Manufacturing Company, some of the most interesting savings were brought about by the more systematic arrangement of the same equipment.

Not so very many years ago, both cotton and woolen manufacturers were able to make fair profits even when their mill equipment was more or less out of date and laid out in a rather haphazard manner. This was largely true because certain mills were able to secure sufficiently large orders on standard goods to keep them in operation at full capacity. Since that time there have been many

new mills constructed, the cotton industry in the South has made rapid progress, and in every line the amount of competition has increased. With this increased competition new machinery has been developed, capable of larger production, new methods have been introduced with the same object in view, and in order to make use of these various methods it is essential that the equipment be properly located.

An Expensive Method

One Massachusetts mill had for many years received its raw material at one end of the mill, carried it through the picker and card room, then brought it back to the first end of the mill, carried it through the finishing machinery and then trucked the finished product back to the shipping room which was at the same end of the plant as the receiving room for the raw material. About a year ago, the machinery layout was changed, so that both of these unnecessary trucking processes were eliminated, and although the change cost a considerable amount of money, the interest on this investment was more than made up after a few months' operations, and the total expenditure has, undoubtedly, by this time been saved.

Concrete Building

The new concrete building above mentioned will be 648 feet 6

Fig. 164A. General View Looking North.

inches long on one side, 439 feet 7 inches long on the other, and about 321 feet 8 inches wide. This lot of land runs from the upper level canal to the railroad tracks, and is situated at the north end of the company's present plant. Two-thirds of the width of this building will be a one-story and basement structure and the other one-third, due to the slope of the land, will be two stories high. The roof will be of the saw-tooth type and the entire

upper floor will be used for a weave room. The basement, under the upper half of the building, will be used for storage purposes. The present weaving department will be moved to the new building, and the rest of the machinery layout will then be designed so as to bring about all possible saving in the handling of materials.

Floor Construction

Figure 164 shows a general view of the new structure in process of construction. The photograph was taken looking south and shows the present buildings of the company in the rear. The entire new building, including floors, columns, beams, roof, etc., is being made of reinforced concrete. Some of the forms for the roof columns and saw-tooth frame work are shown by Figure 164, and this illustration gives a good idea of the way in which the floors are constructed.

The construction is known as the Beam and Tile construction. The diagram, Figure 169, shows the relative position of the tiles reinforcing steel rods and the concrete. The tiles in the floor, shown by Figure 164 are six inches thick, twelve inches square, and are placed in rows four inches apart. In these spaces, the reinforcing rods are placed as indicated by diagram, Figure 169, and the concrete is poured between the tiles and solid concrete 2 inches thick, is placed on top of the tiles. The usual sizes for tiles with this type of construction are four, eight, ten and twelve inches square. In erecting the wooden frame work for the floor, 2-inch by 8-inch planks were spaced eight inches apart, the twelve-inch tiles bridging these openings. The lower weave room has spans 24 feet 6 inches by 15 feet 9 inches, while in the upper weave room every other column is omitted, and by the use of steel beams imbedded in concrete, the spans are increased to 31 feet 6 inches by 24 feet 6 inches.

The wide spaces between the floor tiles are for the main beams, and in these heavier reinforcing rods are placed. After a section of the tile has been put in position, as shown by Figure 164, and the steel reinforcing bars placed, concrete is poured and carefully tamped, making one solid slab of concrete reinforced by tiles and specially designed steel rods.

Roof Construction

Figures 165 and 166 show two detailed drawings illustrating the type of roof construction. The concrete is laid similar to that for floors with the exception that larger tiles are used with only one inch of concrete over their tops. As in the tile and beam floor construction, these tiles do not carry any appreciable amount of load, but simply act as fillers and reduce the amount of concrete which is required. The hollow tiles are placed so that the concrete does not run into them and wherever an open end of a tile comes in contact with concrete, this is plugged before the concrete is poured in exactly the same way as in connection with the floor construction. With a solid concrete roof, more cement would be required and there would be more or less trouble from condensation. By using the hollow tiles, there is an air space provided which prevents this trouble. Four-inch conducting pipes are provided for drainage and the skylights are of the steel sash type which gives a maximum glass area. These skylights are fitted with two thicknesses of glass separated by a three-quarter inch air space to prevent condensation. The nailing strips are placed in the concrete and become an integral part of the same when the cement has set.

On top of the concrete roof there will be a five-ply covering of asphalt and felt laid according to Barrett's specifications.

The Industrial Engineering Company of New York, has the contract

Cost of Concrete Mills

for the construction work and this concern and the United Fire Proofing Company are handling this job together. The Kahn system of reinforced concrete construction is employed. Reinforcing steel and tile are being supplied by the Trussed Concrete Steel Company.

There have been few textile mills built of reinforced concrete, and the owners of this new mill are exceedingly modest in any claims which they are willing to make for this type of building. The engineers in charge of the work and the construction company above noted have erected a large number of concrete factory buildings, especially throughout the West, and on a job large enough to warrant the handling of the work by

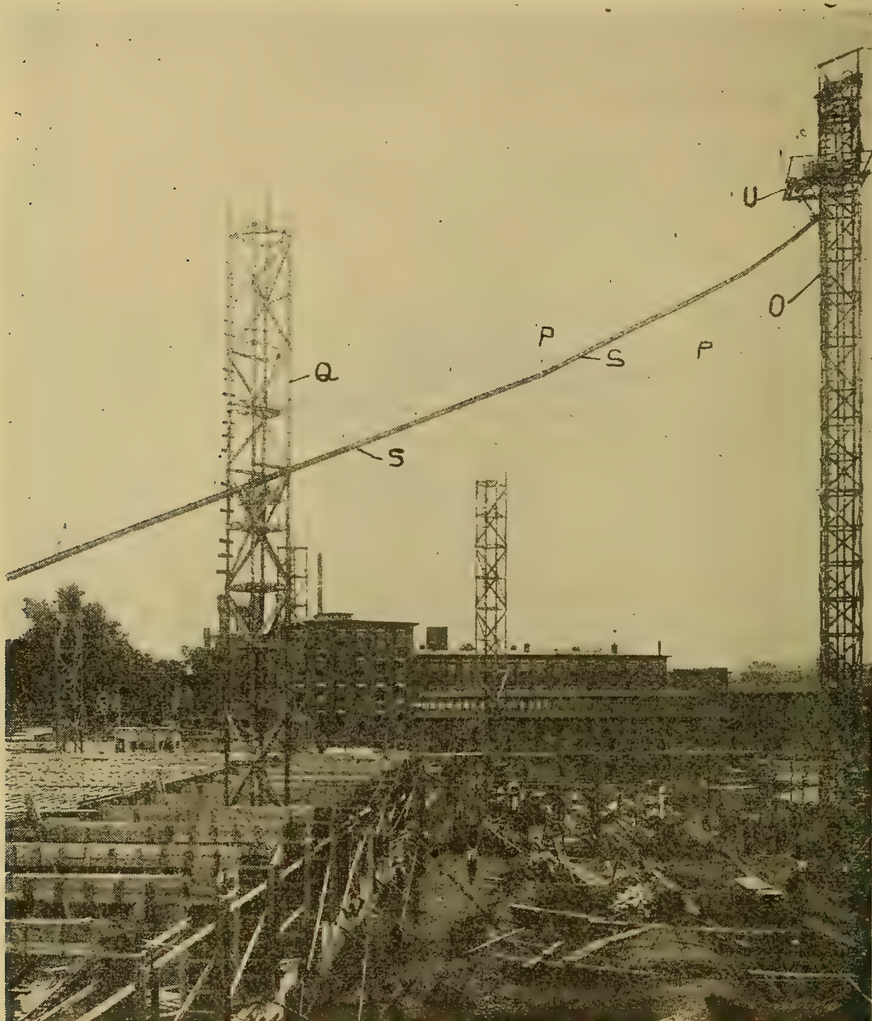


Fig. 167. View Taken About 10 Days Before Fig. 164 Showing Towers for Handling Concrete.

large concerns, it is claimed that in all ordinary instances the reinforced concrete mill buildings can be erected as cheaply, if not cheaper, than one of the heavy slow burning mill type.

In putting up any kind of a reinforced concrete building, a large itancy on the part of most manufacturers. In several instances reinforced concrete construction has received an unfair reputation, so far as appearances are concerned, on account of work being handled and supervised by those unfamiliar with the methods which bring about the best results. In this particular instance, the mill owners hesitated for some

Fig. 168. The Concrete Mixer and Bucket for Unloading Broken Stone and Sand.

Unfair Reputation

amount of woodwork must be used for forms and with even a fairly large building, it is impossible for a contractor, who does not have a great deal of this work, to do it as economically as he could put up a mill of the standard brick and beam construction. Many of the concerns who have had the widest experience in the economical handling of concrete work have not, until the present time, given enough attention to the textile mill business to overcome the natural hes- time before deciding to build a concrete mill, on account of an uncertainty regarding the general appearance of the finished building. A concrete mill building, when designed and built properly is most satisfactory from an architectural standpoint.

One of the principal arguments in favor of a concrete mill building is the elimination of vibration. With even the best mill type structures built of brick and wooden beams, a room full of textile machinery will frequently cause vibrations which will

cause trouble with the machinery's adjustment, and interfere with other departments. The reinforced concrete building, when properly put up, will absolutely eliminate this disagreeable vibration.

ceilings and columns, and while this will appear to some as a small point, it is worthy of consideration.

While all mill men agree that the

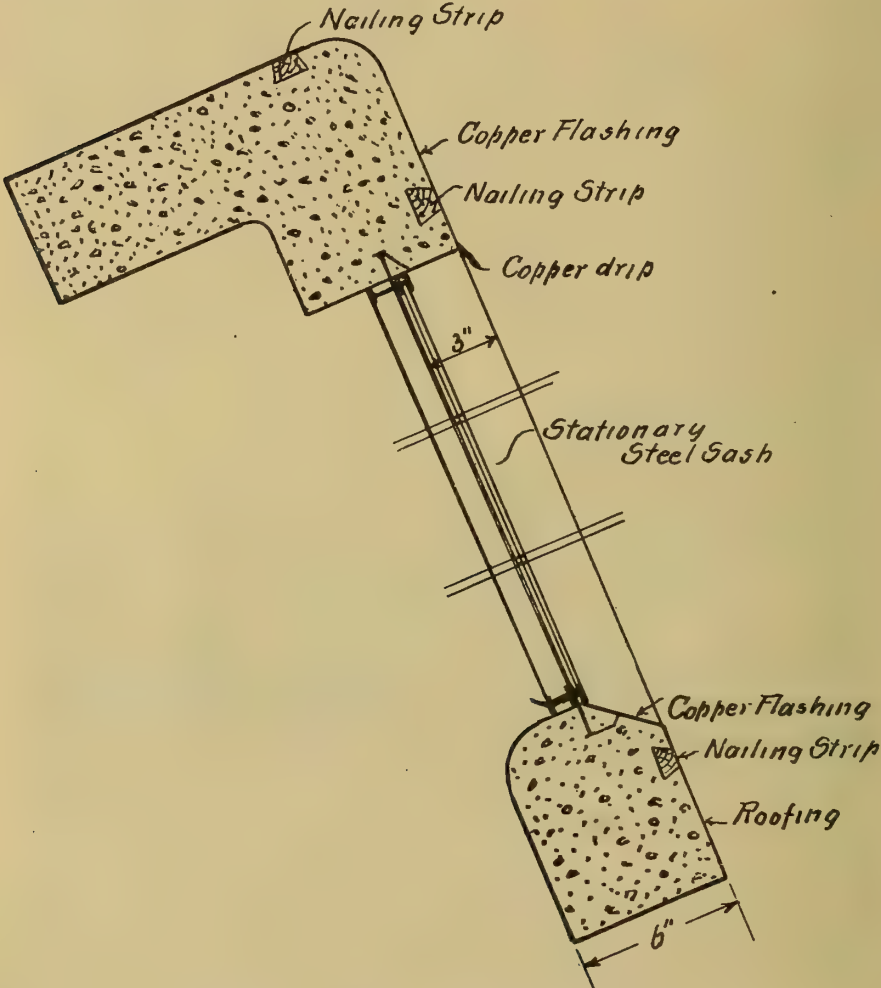


Fig. 166. Detail of Roof Construction.

There is always a certain amount of lint and dust in the card room of a textile mill and where ceilings, beams and columns are of wood, the cotton fibres will collect and require frequent attention. With the concrete building, there is not the same tendency for this lint to adhere to the

reinforced concrete building is the most fireproof structure, many of them argue that by providing certain fire fighting equipments and following instructions given by the most reliable mutual fire insurance companies, they

Fire Risks

are able to secure practically as low a rate of insurance as they could obtain with their building made of concrete. No doubt this is true, but the maintenance of fire protection apparatus costs a considerable amount of money, while with a concrete building, protection from fire is much simplified. If the sprinkler system should fail to operate properly and a fire gained considerable headway, the damage would be confined largely to a single department. With the slow burning type of mill, and especially where mills are located in country districts, there is a possibility of the whole plant being entirely wiped out.

A certain manufacturer in one of our western cities had considered seriously the erection of a reinforced concrete mill. The building was not a large one, and it was possible to put up a slow burning type of building for something like four or five thousand dollars less than a concrete building would cost. To save this difference, the slow burning construction was decided upon. This manufacturer built up a good business and at the end of about five or six years, a fire, started in the night, so damaged his entire layout that before new buildings could be provided, his competitors had obtained considerable business which he would have otherwise held without difficulty. This is only one example of where a desire to save a small amount of money at the outset brought about the loss of a much larger sum, but it is interesting to note that this same manufacturer replaced this building with one of reinforced concrete.

Reinforcing Rods

The reinforcing rods used with the Kahn system have the shear members rigidly attached to the main bars, so that the tendency for the reinforced members to be misplaced during the pouring of the concrete, as would be the case with loose rods and stirrups, is eliminated.

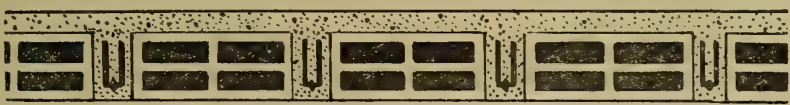


Fig. 169. Diagram Showing Tiles and Reinforcing Rods.

The contract for the new mill has been placed on the lump sum basis, which has made it possible to take advantage of competition in letting out the work. A large amount of work among the textile mills has been handled on a cost plus a percentage basis, which is frequently cost plus about 10 per cent. In a good many instances, this cost plus a percentage has worked out satisfactorily, but some of our most competent construction engineers hold that the cost plus a percentage is generally more expensive and is no better, providing the work taken on the lump sum basis is properly followed and inspected by engineers representing the owners.

Inserts for Pipes, Hangers, etc.

The roof of this weave shed, while of concrete, will have no tie rods. Part of the building will have spans 24 feet 6 inches by 31 feet 6 inches, and columns 13 inches square. There will be 28 feet clear from the floor to the apex of the saw teeth, and it is estimated that the cost of this building will be less than 90 cents a square foot.

Special inserts have been placed in the concrete to allow for fastening the shafting for installing power and light wires and for the sprinkler pipes. The machinery arrangement has been planned with sufficient care, so that the engineer in charge of the work claims that it will not be neces-

sary to drill more than ten or twelve holes at the very most through the concrete.

There will be a brick curtain wall and on top of this the steel sash windows will be placed, which eliminates the necessity of wide mullions. These steel sash windows will extend to the ceiling and will be equipped with pivoted ventilators.

It is interesting to note that the same system of piping which supplies water for the sprinkler system will also be utilized for heating purposes. Hot water will be circulated through the sprinkler pipes during the cold weather, so that the piping costs will be materially reduced. This system of mill heating has been used in one of the New Bedford mills for something like two years, and has proved decidedly satisfactory.

Fig. 170. Enlarged View of One Reinforcing Rod.

Figure 167 shows another view taken about ten days before Figure 164, and the central dividing wall between the two-story section and the one-story and basement section is marked W. The wooden forms for the vertical column and for the floor beams are also shown by Figure 167. The regular columns in this building are made up with vertical steel rods tied securely together and imbedded in solid concrete. The railroad tracks are at the extreme right of Figure 164 and the upper level canal at the extreme left. The towers marked O and Q are temporary wooden structures, built to facilitate the handling of the concrete.

Mixing and Handling Concrete

Figure 168 shows the concrete mixer which is located at the extreme lower end of the lot. The freight siding of the railroad is shown by this illustration, and it is interesting to follow the modern method of handling the sand, broken stone and cement from which the concrete is made, as well as the economical way in which this concrete is handled and poured. In Figure 168 an ordinary steam-operated derrick is shown at D having a large self-filling bucket marked C. At J and K there are two bins for holding broken stone and sand, respectively. Underneath these bins is the concrete mixer indicated by arrow M. Sheds F, G and L are used for storing cement, there being a small industrial railway laid from the sheds G and F up the incline M and into the larger shed L. As is indicated at A and B, the freight cars containing sand, broken stone or cement are brought opposite the derrick and are quickly unloaded with very little hand labor. The broken stone is taken with the bucket C and dumped into bin J. The sand handled with this same self-filling bucket is emptied into bin K.

Underneath these bins there is a measuring device so that the proper proportions of sand and stone may be quickly determined, and the cement and water are added at the mixer M. From the mixer the concrete is poured into a specially designed tip car at the foot of tower O. This car of concrete is then raised rapidly by power to the platform U near the top of tower O. A metal trough or chute runs from the unloading platform U through tower Q to the distributing bin R. This chute is made of several sheet-iron sections supported by pulley blocks, as indicated, and can be shortened or lengthened as it becomes necessary to change the delivery bin R. The delivery end of the chute is placed in a central location for a certain section of the work, and from R the concrete is wheeled by hand on tip cars. A considerable

amount of space upon one level can be economically covered with the hand cars, but the delivery end of the chute can readily be changed and can be raised or lowered as required.

This type of construction gives a most substantial building, one which is fireproof, and by employing labor-saving devices such as those just indicated for handling and pouring the cement, the cost can be kept low enough to make this type of building often more desirable than the standard mill type.

Fig. 156. Interior View, Looking South, Weave Shed of the Chicopee Manufacturing Company.

A Modern Weave Shed

About two years ago, the Chicopee Manufacturing Company built a new saw-tooth roof weave shed and installed 648 forty-inch Northrop looms. One floor of the old mill near the new weave shed was until recently rented to an automobile concern, but the dressing machinery has now been moved to this floor, so that the product has but a short distance to travel from the dressing machinery to the looms. The new weave shed has been built with a temporary wooden end, as it will probably be necessary to extend this in the near future. This probable extension has been considered in locating the dressing department so that after the weave shed is completed the stock will be handled even more economically than it is at the present time.

Figure 156 is an interior view of the new weave room looking south. The roof windows admit the north light, and an exceptionally fine illumination is obtained. Saw-tooth roof construction is far from new, but in the erection of this particular weave shed a great many objectionable features were eliminated, and at the same time the cost of the building was kept low.

Machinery Layout

The machinery layout was first settled upon and the looms arranged in groups of six. The bays were made wide so that the six rows of looms might be placed between the columns. Figure 157 shows a cross-section of one bay and illustrates the type of roof construction employed in order to make it possible to have the distance between the columns, that is, the width of the bays, twenty-seven feet. As shown by Figure 157, the roof is supported by steel trusses, which in turn are carried on cast-iron columns, six inches in diameter. On these columns there are twenty-four-inch eighty-pound I-beams, which run lengthwise of the shed and have a span of thirty-four feet. The trusses are riveted to the side of the I-beams, and this construction gives a stiff roof, and at the same time, brings the bottom of the skylights near the cloth surface of the looms.

Before constructing this shed, experiments were made which showed that the diffusion of light or the causing of shadows on the cloth in looms was directly dependent upon the distance between the bottom of the skylights and the cloth. Some weave sheds were found so high studded that shadows were produced by the hand when held approximately 12 inches above the cloth. With the construction illustrated by Figure 157 shadows are scarcely perceptible when the hand is held four inches above the cloth.

Diagonal Flooring

The walls of this building are of concrete blocks, and instead of building pilasters, which would have required a different form of block, the wall was reinforced at each point where the girders are supported by the use of small columns built up of two 6x3½ inch ell irons. The concrete blocks were made on the ground as required. As seen by Figure 157, there is a low basement, and this was provided for piping, shafting and electric motors. The walls of the basement are of solid concrete, with no windows, except where necessary for ventilation. The bays in the basement are 9 feet in width by approximately 12 feet span. Floor timbers are 10x12 inch Southern pine, and the floor consists of 4-inch planking, which is not splined or tongued and grooved, but which is reinforced by 1-inch rough intermediate flooring, running diagonally across the lower floor planking. Care was taken to have this diagonal floor securely spiked down to each floor plank. On top of this, there is a ⅞-inch maple floor, made up of strips not exceeding 3 inches in width. This top flooring is not tongued and grooved, for in many sheds it has been found that the shrinking and swelling due to frequent washings cause much trouble, where the tongued and grooved boards are used.

In order to prevent condensation on the overhead steel structure, no portion of the roof that is exposed to the cold air is allowed to touch the steel structure. The top of the nailing strips are raised almost one-half inch above the top of the trusses, and the valleys of the roof are about four inches away from the supporting I-beams. The roof itself is made up of 3-inch splined sheathing fastened to spiking strips, which are bolted to the side of the top chord of each truss. On top of this sheathing there is a covering of seven-ply plastic slate.

The temporary wooden end of the shed shown at the left of Figure 156 contains no windows, and no windows were provided at the other end. The wall on the north side contains sixteen or eighteen windows, and in the south wall there are two large exhausters, which draw the foul air from the room and allow the fresh air to come in from outside. These exhausters are shown in Figure 156.

Roof Drainage

Saw-tooth roof weave sheds which have been built in the North have often given trouble by allowing the valleys to become filled with snow, which at times of a sudden thaw may cause serious leaks. The weave shed

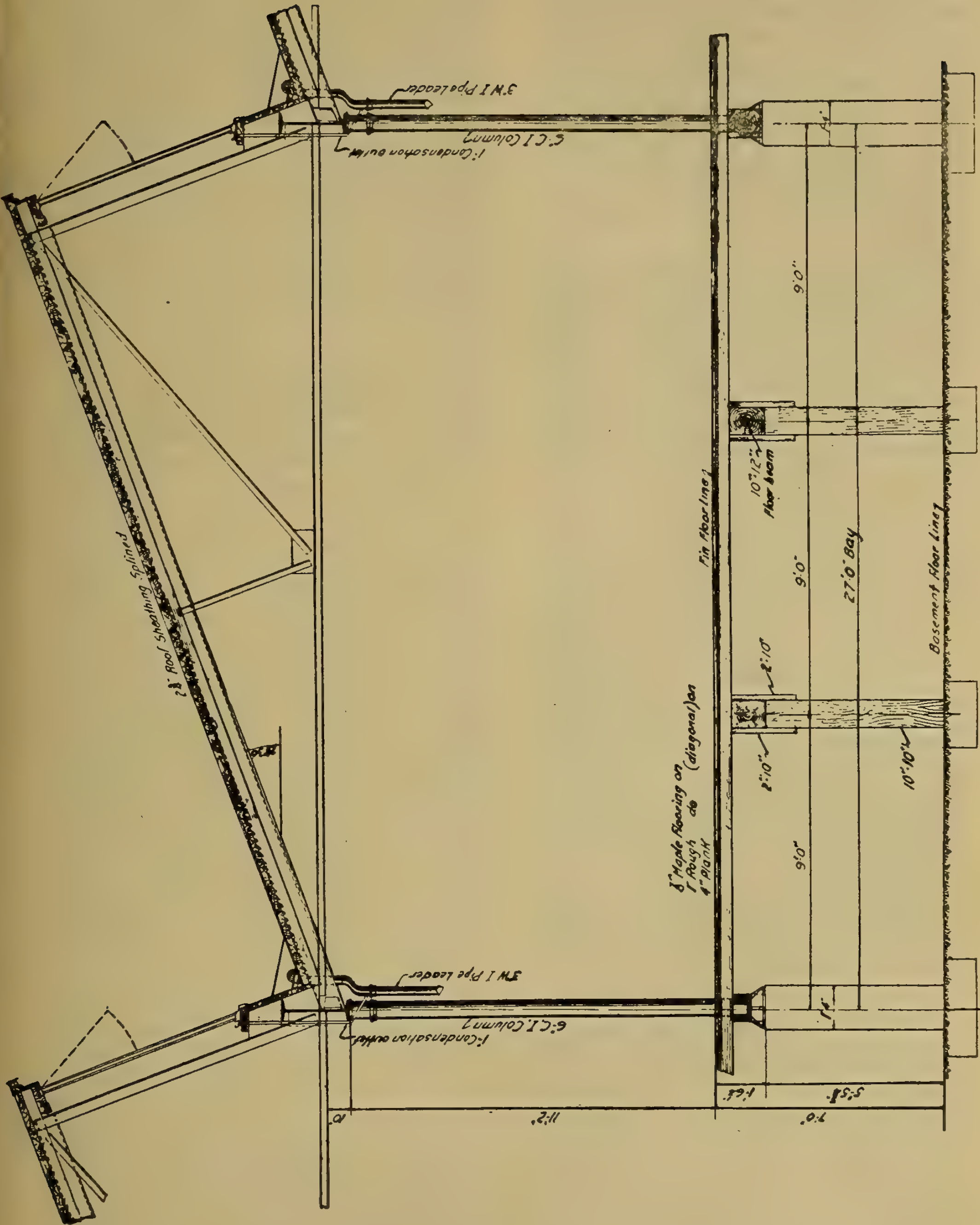


Fig. 157. Cross-Section of One Bay—Saw-Tooth Weave Shed.

of the Chicopee Manufacturing Company has a 3-inch wrought-iron pipe running from the roof to the basement at each of the posts. This gives a distance of 34 feet, 4 inches between these pipes, and the valleys are built up so as to give a pitch of approximately 14 inches in 17 feet. This design has given good results, and there have been no leaks. The vertical pipes are covered with strainers to prevent foreign matter clogging the drains.

Ground was broken for this new building March 28, and by July 1 the building was completed, with the exception of about one-quarter of the top maple flooring. The work was performed on the "Cost Plus a Percentage Basis," and cost, without equipment, $47,628. This included engineering fee and contractor's profit.

Cost Figures

The building is 252 feet 10 inches long by 140 feet 10 inches wide, and has an addition for cloak and toilet rooms 25 feet 10 inches by 14 feet 8 inches. The shed is connected with the other mill buildings, so that the total floor area amounts to 36,010 square feet. The main room has 35,084 square feet of floor surface, of which 33,890 square feet come under the skylights. The skylight area is 8,652 square feet, giving a ratio of one square foot of skylight for 3.92 square feet of floor surface.

The cost per square foot of area, figuring on the basis of 36,000 square feet, is as follows:

$1.323 per square foot of area divided as follows:

Excavation	$ .048
Concrete footings and foundations	.079
Structural steel	.180
Posts and girders	.079
Flooring complete	.274
Concrete blocks (making and setting)	.079
Wood wall	.034
Roof complete	.360
Doors and windows	.014
Painting	.045
Engineering	.076
Superintendents, clerks, etc.	.045
Construction, plant and tools	.010
Total cost	$1.323

The above costs are based on the following unit prices for materials:

Structural steel and columns delivered on the ground (per ton)	$45.65
Concrete for foundation wall, columns and footing, including forms (per cubic yard)	10.27
Cost of labor for erecting steel work (per ton)	5.74
Timber (rough) long leaf yellow pine (per 1,000 ft.)	29.75
Floor plank, long leaf yellow pine (per 1,000 ft.)	28.25
Splined roof plank, leaf yellow pine (per 1,000 ft.)	29.00
Siding and intermediate flooring (per 1,000 ft.)	21.00
Top maple flooring (per 1,000 ft.)	33.00
Portland cement (per barrel)	1.23
Broken stone, net (per ton)	1.20
Skylights delivered and erected (per square foot)	.41

Saw-Tooth Roofs

The saw-tooth roof has shown itself to be of great value for mill buildings and is now almost always used for the weaving department. Looms are generally placed in a one-story building which is lighted from windows in the saw-tooth roof. Many weave sheds are one and a half or two stories high, but where this is true, the basement or lower floor is generally used for preparatory machinery or given up entirely to shafting which drives the looms. It is best where possible to give the windows a northern exposure, as this light is fairly uniform throughout the entire day. Windows which will get strong sunlight are objectionable, and some weave sheds are built without any side windows. The weave shed of the Maverick Mills is an illustration of this type of construction, and excellent light is obtained from the roof alone.

Condensation

In developing a type of saw-tooth construction suitable for mills, many difficulties were met which had to be overcome. Condensation, which forms upon the inside of the windows, will run down the glass and unless some means are provided for collecting this, it will drop upon the machinery. Engineers have brought out many ways of avoiding this difficulty, some of them being

complex and necessitating considerable extra expense. In some cases double glass is used, but this has not always been satisfactory, and for a large building it has been rather expensive. It is easy to build the saw-tooth roof with proper provision for collecting all condensation and conveying it to the main roof, or to a sewer connection. By using small metal troughs and by doing away with all cross sashes which divided the window glass horizontally, the condensation can be prevented from dripping into the room. Where saw-tooth roofs are used, it is customary to provide metal ventilators at frequent intervals. These give rise to still further trouble from condensation, but manufacturers have designed special arrangements for carrying away this moisture and preventing it from doing damage.

Poor Construction

Much of the trouble which some have had with leaky saw-tooth roofs has been caused by insufficient flashing and other poor construction details. Unless a wide flashing is provided at all points, where the slope of a roof changes, there is sure to be trouble from rain and snow beating in. Many contractors have slighted this small point, and in consequence of this, mill men have sometimes been led to believe that it is next to impossible to have one of these roofs made weather tight. This erroneous belief is gradually becoming a thing of the past, and the number of contractors who slight these matters is becoming less. The same kind of difficulties have been frequently met by Southern mills, which have had much trouble with leaky monitors. In the South, where the tendency to use partially seasoned timber is even greater than it is in the North, there have been many mill monitors which have become so warped by the sun that rain would beat in at every storm. Some Southern mills have been known to complain to the Northern mill architects about this trouble when in reality the design for the building was proper had the building been constructed according to drawings, and had suitably seasoned materials been used.

Ventilation

Mill ventilation is overdone by some, but it is far more often that this question is sadly neglected. Textile mills are generally better ventilated than most other manufacturing establishments. This is partly due to the important effect which humidity and atmospheric conditions have upon the stock in process. At some plants, expensive and complex air conditioning systems have given no better results than might be obtained from some of the simpler kinds of equipment.

The maintenance and operating costs should be considered, but manufacturers should not be satisfied with an efficient method of supplying moisture to the room, without proper provision for supplying fresh pure air. With some humidifying systems outside air is moistened, heated or cooled to the desired temperature, and then forced to the various parts of the room. Some arrangements of this kind work out admirably, and with them it is easy to maintain uniform conditions throughout each room. Humidifying units which deliver moisture directly into the mill room work satisfactorily if sufficient attention is given to the matter of ventilation. There are also many departments in which no humidifiers are used, and the condition of the air in these rooms is frequently bad. Most of our modern mills are heated by steam or hot water, and where the direct heating method is employed, the condition of the air is sometimes neglected. Our new mills generally have this detail properly cared for, but in many instances old buildings are remodelled and machinery rearranged without giving much attention to the problem of securing the proper ventilation.

There are many styles of metal ventilators now upon the market. Figure 131 shows one type of ventilator cut away so that the damper arrangement is clearly indicated. This illustration shows the apparatus with the damper

open, and Figure 132 shows a similar ventilator with the damper closed. The mechanism illustrated for operating the damper is simple, and especially efficient. With some ventilators a simple swinging damper is provided, and these sometimes become wedged and will not open properly. In cases of this kind, the ventilator is frequently neglected and becomes of no value. With the damper ilustrated by Figures 131, 132 and 133, it is

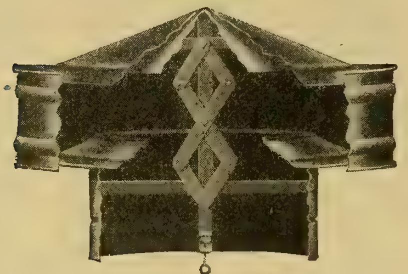


Fig. 131. Mill Ventilator with Damper Open.

not necessary to fasten the cord which operates the damper, as a locking device is provided. The damper is closed by pulling a cord which releases a steel locking device. For certain classes of work, such as ventilating dyehouses, bleacheries, etc., where the light is none too good at the best, it is important to utilize light through the ventilator. By making the top of the ventilator of wire glass, and by having the damper of the same material, considerable light is supplied, regardless of whether the ventilator is open or closed. Figures 132 and 133 illustrate these glass top ventilators.

Skylights

Several new textile mills have been arranged so that the spinning machinery is placed on the top floor. By doing this and putting in large skylights, excellent illumination is obtained. The new Amory Mills at Clinton, Mass., is one illustration of this, and the room is especially well lighted. Where light can be obtained from a roof, the machinery can be arranged in any manner, regardless of whether light from the side windows is partially interfered with or not. Machinery placed on other floors of the mill must be arranged with due consideration to this matter. Efficient and practical ventilators can easily be supplied in connection with each skylight.

Economical Distribution

Many possible advantages of electrically driven textile mills are neglected. Some have introduced electric drives without knowing how to get the most out of the new arrangement, and have taken little trouble to determine whether or not their equipment is properly arranged. So long as the motors furnish power without giving trouble, the question of whether the most economical sizes are being used for each group of machinery is frequently forgotten.

The motor builder wishes to give the mill an economical lay-out, but unless the mill man will do his own part, both sides are working more or less in the dark. It is true that an extensive change in equipment is generally made under the supervision of an engineer, but the most competent of these may recommend distribution systems which should be somewhat changed after the arrangement has had a fair tryout under actual man-

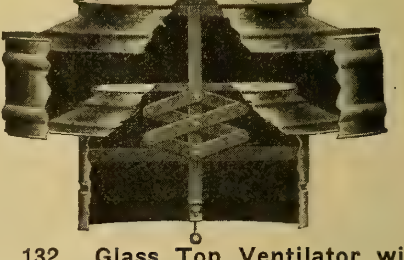


Fig. 132. Glass Top Ventilator with Glass Damper Closed.

ufacturing conditions. Where the exact amount of power required to operate a certain group of machinery is not accurately known, before the motors are installed, a certain allowance must be made in order that none of

the motors may be overloaded. The approximate amount of power required for the machinery is known in advance, but the mills which have previously been operated with mechanical transmission will naturally utilize some of the old lines of shafting, and the uncertain amounts of friction introduced together with many local points, such as the condition of the machinery itself, will have an important effect upon the total power required for each group. The initial installation should be designed according to results attained in other similar plants, and data should be used which is known to be accurate. After the outfit has been put in operation, it is up to the mill man to find out what he has gained by the change.

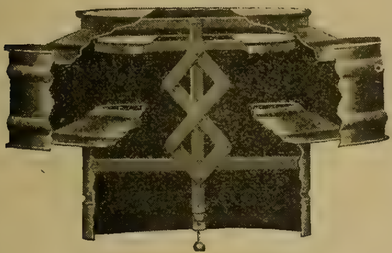


Fig. 133. Glass Top Ventilator with Damper Open.

Valuable data upon the amount of power used by textile machinery as well as that required for engine and friction losses has been obtained by dynamometer measurements. Results obtained from tests of this kind are important, but the dynamometer at best is none too accurate. It is inconvenient to handle, and many times the data obtained is of little value.

Mill Heating

When reading over a general account of new mills and additions covering a certain period of time, such as are published regularly by some of the textile journals, one may well remark the different styles and types of equipment employed for the same nature of business, especially in regard to the heating facilities which all must have, and he often finds that two plants in close proximity to each other and subject to the same atmospheric conditions, whose managers have, through knowledge acquired by previous experience or advice given them by their engineers, adopted two entirely different systems.

Taken in a general way,

THE THEORETICAL VALUES

of all heating systems are the same, that is to say, a certain amount of heat imparted to a system from a given source will account for itself in some form or other, no matter what the type of distribution may be; and if, for instance, a million heat units are sent out, one million heat units, no more and no less, will be available for heating purposes. It is one of the fundamental natural laws that a warm body will impart heat to a cooler body until the temperature of both becomes the same, but it is impossible to return the heat by any means to the former warm body and restore the first condition without supplying new heat, as that which is once dissipated is lost forever. On this account any system of heating which is so arranged that the heat in its passage from the supply to the point of actual distribution and utilization is subjected to more influences which tend to absorb it than another system, it cannot give the same practical results, although, theoretically, both may be of the same efficiency. To heat a room in regular winter weather the real medium by which the warmth is imparted to the room (whether it be a pipe or a volume of air heated before its entrance) must be a great deal warmer than the at-

mosphere which it is supposed to heat, or it will be necessary to have the distributing systems altogether too expensive and cumbersome, and equipment which is adequate in moderate weather, carrying heat at a temperature slightly above the surrounding air, will utterly fail when the weather begins to be severe.

In textile mills the condition of the atmosphere in regard to

MOISTURE OR HUMIDITY

is an important feature, and in addition to the necessary warmth, a certain amount of water must be carried in suspension in order that the materials in process may be in the proper condition, and for this reason, all rooms of a factory must be made as independent as possible of outdoor atmospheric conditions.

A successful heating system for a textile mill must be constructed of the best of material and well put together. It must be elastic and easily controlled; have abundant reserve capacity; be compact, durable and easily accessible for repairs, and, in addition, must be efficient and economical in fuel consumption.

A brief consideration of the different standard systems in relation to their ability for fulfilling the above conditions will perhaps bring to notice more plainly than any other way the principal characteristics of each type.

The direct steam system which is so well known will be taken first. This arrangement consists of coils of pipe erected along the sides or ceilings of rooms, through which steam at a moderately high pressure is circulated. As the temperature of the steam is quite high, only a small amount of radiating surface is required, so that a few small pipes are usually sufficient for ordinary conditions, which take up little room and are not expensive to install or keep in repair. When a system of this kind is so situated that the condensation can be

RUN TO TRAPS

and from them returned to the boilers at a high temperature, very economical results can be obtained. The high temperature of the pipes, of course, means a corresponding high temperature of the atmosphere in their immediate vicinity, and unless some means are present for circulating the air, the rooms will be too warm near the coils and too cool at some distance away from them. If the rooms contain revolving pulleys and shafting, the circulating is performed without extra apparatus, but if not, a series of circulating fans will assist greatly in distributing the warm air and equalizing the temperature.

Where it is necessary to turn the condensed steam to waste, the expense of operation increases greatly, as the heat contained in the water is lost and a new supply has to be provided from the boilers to replace it.

If the boiler plant, however, furnishes steam for power purposes and plenty of warm water can be had from the condensers, and subsequently heated by economizers, etc., the loss is not so appreciable during running hours, but at night and on holidays (when the larger part of the heating is done) the condensation must be made up by water at atmospheric temperature or lower.

This system, if supplied by steam through

A REDUCING VALVE,

with considerable excess pressure on the supply side, can be forced to a great extent by simply raising the pressure, an advantage often made use of in times of very severe weather and one which few of the other systems possess. In some plants the heating lines are made larger than is the general custom for direct steam heating, and at times exhaust steam at a low pressure is used instead of that direct from the boilers. This seldom gives satisfaction, as the speed of circulation is so low that parts of the system remote from the entering point are filled with water at a low temperature and of no use as a heating medium.

If a system constructed as above and employing steam at a low pressure is provided with some means for creating a constant circulation, regardless of the initial pressure, we

have what is known as the "vacuum system," and one which possesses as many, if not more, advantages than any other type known.

The idea of installing a pump to draw the water from the return lines of a system is seemingly a very simple matter, and were this all that was required to accomplish successful results, the vacuum system would have been in general use long ago. There is, however, a serious difficulty in the way of pumping the hot fluid, which is due to the presence of steam and vapor with the water and which impairs the vacuum produced by the pump, and consequently prevents the proper circulation through the system. To remove this difficulty some means of

SEPARATING THE STEAM

and air from the water had to be provided. These devices, which are known as "water seals," or "air valves," have been only moderately successful until within a few years. These appliances, while supposed to perform the same duty, are somewhat different in their principle and action.

One type depends upon some substance which changes its form materially at different temperatures, so that when in contact with the condensation it acts upon the outlet valve and opens it, but allows it to close the moment steam with its much higher temperature begins to pass. One of these devices is attached to every section of heating coils, or every radiator, and by preventing any vapor from entering the return pipe the pump is able to maintain a vacuum and remove all water as fast as it collects. Another type of water seals, which is much more positive and reliable, is that which is operated by the action of a float, which is buoyed up by the water when it enters the body of the appliance and thus opens the outlet valve. In this type a small outlet is also provided to allow the escape of air, and is always open when no water is present. This positively prevents any "air binding," and allows the coils to warm up immediately after the steam is turned on.

In any system employing a vacuum it is necessary that the pipes supplying the steam, as well as the radiating pipes, be of ample size, so that the work may be done with steam at a low pressure, and also with a low vacuum, as too great a range between the two interferes with the proper working of the "water seals."

THE VACUUM SYSTEM,

when properly installed, is perhaps the best adapted of any for the utilization of waste steam, or cheap steam, as the exhaust from pumps or auxiliary engines, as well as "receiver" steam from compound engines can be used alone or in conjunction with direct steam from the boilers (which has been reduced to the desired pressure through a reducing valve), and at all times without affecting the heating service. In connection with the question of the size and number of pipes required to do a given amount of heating it is interesting to note the difference sometimes seen between the theoretical and actual, a good illustration being presented in a mill building recently erected.

This building has four floors, and is heated by the vacuum system. The first floor is, on account of the location of the building, partly below the ground, while the second and third are exposed to the weather on all sides. The fourth, or top floor, is also exposed on all sides and has in addition large skylights in the roof.

The engineer in charge of the laying out of the system (who was employed by the contractor furnishing it) figured that the two intermediate floors should have the same amount of radiating pipes, the lower floor about 25 per cent more, and the top story 50 per cent more, taking into consideration probably that the heat from the lower floor would assist in heating the two above and that on account of the skylights in the roof much of the heat would escape through them.

THE ACTUAL RESULTS

for two seasons have been that the lower floor is heated too much, the second floor too little, the third nearly right, and there is such a surplus

of heating capacity in the upper story that the circulation is allowed to run only a few hours out of the twenty-four, even in the coldest weather. It follows, then, that had a few lengths of pipe been added to the second floor coils, and approximately half of those in the upper and lower rooms left out, there would have been a great saving in the cost of the installation, while at the same time, better results would have been obtained.

Heating by means of pipes filled with hot water instead of steam is one of the best known methods, and every one is familiar with this system as applied to house heating, but when employed for large buildings the circulation of the water by means of the expansion caused by heat alone cannot be depended upon for distribution, and therefore some power has to be employed to perform the work. We then have the "forced circulation hot water system," which is used in many mills. This type requires, like the low-pressure steam systems, a large amount of radiating surface, and, in addition, a much more complicated plant is necessary for pumping the water through the circuit from heater to coils and back again in continuous motion.

The heaters for this system are generally placed so that steam can be taken directly from the boilers, and if possible, they are situated above them to allow for the use of

A GRAVITY SYSTEM

for returning the drip or condensation. If the whole or part of the heating coils are designed for the use of exhaust steam, it must be remembered that in order to utilize the heat from such (if it is used at atmospheric pressure) the temperature of the water in the circulating system must be kept below 212 degrees, or no heat will be absorbed therefrom, and if in severe weather a temperature higher than this is desired exhaust steam cannot be utilized. In case of accident to the power for driving the circulating pump, the hot water system is seriously crippled, as any attempt to use steam temporarily in pipes usually filled with water and containing, as they do, numberless low places or "pockets," is almost sure to result in broken fittings and other damage caused by "water hammer." This exigency, when occurring with a steam or vacuum system, is taken care of without any particular risk or trouble, the only change needed in case of a break-down on the pump being to raise the pressure enough to cause a circulation without a vacuum and discharge the condensation through the "emergency drip" valve.

In some places the hot water system is supplied with heat from heaters installed in the exhaust pipe of condensing engines, and the amount of heat imparted to them regulated by

CHANGING THE VACUUM

with which the engines are working. This is feasible if all the steam exhausted can be utilized, but if any more is made and discharged at a reduced vacuum the waste is considerable, as vacuum applies to the engine throughout its entire stroke the same as "mean effective pressure," and the loss of a few pounds in a cylinder of large size means a great loss in the power generated from a given quantity of steam.

The "indirect" or fan system of heating has been exploited most strenuously by its advocates for many years and is used to a considerable extent in textile plants, although the results obtained have not always come up to the expectations of those interested, and while it has been very successful in some lines of work, the impression seems to grow that it is comparatively expensive both in first cost and operation. This system consists of a set of heating coils arranged in any convenient place, through which fresh air is drawn by a circulating fan and then discharged into the rooms.

As the entire volume of air in a room is renewed every few minutes its condition is under perfect control, and with proper manipulation, a combined ventilating and heating system may be obtained. This accounts for the great favor in which this system is held for heating public buildings, etc., where by the use of "mixing dampers" and other appli-

ances an atmosphere may be secured which is not only comfortable but wholesome. The feature of a constantly changing atmosphere, however, is not desirable in textile manufacturing, as it is very difficult to maintain a condition under which the materials in process may be worked to

THE BEST ADVANTAGE

with too free connections with the outdoor air.

The principle of introducing the air into a room by the fan method necessitates a continuous motion of the air, a fresh quantity entering and a corresponding quantity leaving, which carries not only the impurities, but heat which must be made up by heat in the entering volume, or the temperature cannot be kept constant. Therefore, an excessive amount of heat has to be supplied, as compared with other systems, to give the same heating results, which proves that the impression alluded to in regard to expensive operation is not altogether imaginary.

In certain departments of a textile plant in which the processes of boiling or drying are carried on, and where a great amount of moisture is liberated, there is an excellent field for the fan system, and, in fact, it is the only one that can perform the duties of removing the vapors and moisture successfully. This may be used alone or in combination with permanent heating coils, the main requisite being to build up a light pressure in the room sufficient to force out through any openings the vapor-laden air and supply in its place

WARM DRY AIR,

which, in turn, may absorb the moisture and pass out.

When this idea is carried out to its fullest extent it is known as the "plenum" system, and in rooms so equipped, it is possible to carry on work involving processes which liberate poisonous gases or vapors, as well as moisture, without injuring the interior of the building or causing discomfort to the operatives.

The question of quality of heat in regard to its being agreeable to the senses is one which has received little or no attention when considered in connection with textile mills, although it has been thought quite important in selecting a system for public buildings and residences.

As every one knows, the heat from a closed stove or open grate burning wood which imparts no disagreeable gases is much more comfortable than that from any system heated by steam. The reason, however, has not been clear, and at the present time, there is much difference of opinion and uncertainty in regard to it.

The advocates of the fan or indirect system claim that the heat supplied by this arrangement is more comfortable, the dry baking feature of high pressure direct heat being less in evidence. That this is a more or less fallacious argument was proven several years ago, in one instance where a wood manufacturing concern desired to equip a new addition with the most up-to-date apparatus and avoid, if possible, the dry uncomfortable heat which was the cause of much complaint from the workmen in the original plant having the ordinary direct steam system.

THE FAN SYSTEM

was installed, but much to the surprise of every one, the rooms were much more "stuffy" and uncomfortable than in the rooms served by the old system.

The theory that hot water heat is superior to steam in regard to quality is also advanced and quite generally believed, which, together with that in relation to other systems, is a mistaken idea based on the belief that there is a possible difference in the heat imparted, when in reality the quality depends upon the condition of the atmosphere into which the heat is discharged and not on the heat itself.

That heat of a certain kind when introduced into a room is the means of impoverishing the air and obstructing ventilation cannot be true is attested by the fact that a room without heat or ventilation and unoccupied by anything will after being closed for a time have the same stuffy feeling which prevails when the sup-

posed objectionable heating element is present.

According to the results of extensive experiments carried on in Germany, it has been found that the quality of heat in a room is directly dependent upon the quantity and nature of the dust particles present, and which if they are of an organic nature will decompose into gas when in contact with heating surfaces from a temperature of 160 degrees Fahrenheit, or higher. The quantity of these is seldom sufficient to really poison the air, but their presence is often noticeable by the disagreeable odor imparted.

THE INVESTIGATIONS

further showed that dust collected in certain parts of a room, being precipitated on account of moisture contained or having greater specific gravity than the floating dry particles, would decompose with less heat than those in suspension, and gases from them would become noticeable at a temperature as low as 190 degrees. Thus we have here a solution of the puzzle in regard to the quality of heat obtained from different systems, for in carrying out this line of thought it is evident that in a system where the heated surfaces are directly in contact with the atmosphere of the room, the lower the temperature carried in them the less dust decomposed and the less injurious gases liberated. This accounts for the superiority of the low pressure steam or hot water systems over the high pressure.

With the indirect system another condition is present which offsets partly the advantage of having the heated surfaces outside, as the atmosphere is kept in a more agitated state, causing the dust particles to be deposited where a moderate amount of heat will decompose them and also carry more in suspension than when the air is in a more quiet state, as with the direct system.

In the case of the wood working plant mentioned the enhanced agitation not only caused more gases to form (as the system was installed for a high pressure steam supply for heating the coils), but, assisted by the agitation of revolving shafting and pulleys, carried an increased quantity of the wood dust always present in works of this kind in suspension and rendered the air almost unbearable.

Had this system been installed in a public building, or where very little dust is present, and provided with mixing gates, etc., for conditioning the air properly, most excellent results would have been obtained not on account of the

DIFFERENT QUALITY

of the "heat," but because the arrangement of the system and the principle of its operation would in this case have assisted in reducing the amount of decomposed dust particles to the minimum.

The custom, which is prevalent in many manufacturing plants using direct heating, of placing the coils upon the ceiling of the rooms (while being about the only practical way for several reasons) is one which tends to produce some discomfort on the part of the operatives who work under them, and although having no connection with the other causes for producing an uncomfortable atmosphere, it can be readily understood that the coils if heated by low pressure steam or hot water would be far less objectionable than those using high pressure steam and an accompanying high temperature.

Design and Care of Mill Shafting

The shafting system in the average mill is one of the most important elements which enter into the successful operation of the plant, and is one which should, therefore, receive a large proportion of the thought of those who have to do with either the initial installation of the power and transmission equipment or its subsequent operation and upkeep. Improved methods for the manufacture of shafting for power purposes have been introduced which have revolutionized the shafting business, and genuine wrought-iron shafting is little used, special steel having taken its place almost wholly, except for the very largest work, where we still see some of what is known as "hammered iron."

STEEL SHAFTING.

Steel shafting is seldom made by simply taking steel in the rough and turning to size in the same manner as the original wrought-iron was worked, but it is produced by some special process which is, in a way, peculiar to the individual company making it, although the methods employed resemble each other in principle. One of the best known is the "cold rolling" process, which is used by several of the very largest producers.

In this process the steel is taken in the round bar as it comes from the hot rolls and turned to nearly the size desired on high-speed automatic machines, which remove an immense amount of metal in a short time, and consist of two cutters placed in a revolving head, similar to a pipe machine (in which the dies or cutters revolve), and the steel bar is slowly fed through them. By this method two heavy chips can be taken and the labor of "centering," which would be necessary in the case of turning in a lathe, is done away with.

The homogeneous nature of steel allows this type of machine to be used but in the case of wrought iron, with its laminations and hard streaks, it

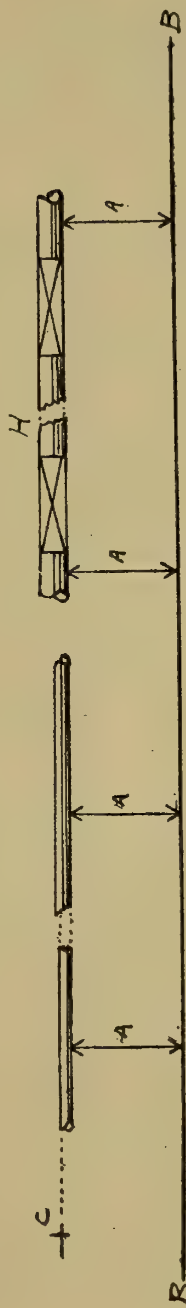


Fig. 1.

A Typical Example of Poor Alignment.

would be impossible to operate high-speed cutters with any degree of success. To prevent trouble from the hard places always present on the outside of the steel bars known as "roll scale," but which never extend into the body of the metal, the stock is passed through a "pickling vat," in which the scale is softened or removed entirely by the action of powerful acids.

After the shafting bars have been machined within a small fraction of an inch to the desired diameter, it is put through the cold rolls, which are rolls placed in a revolving head in the same manner as the cutters in the turning head and which are forced against the metal with sufficient power to

SQUEEZE THE OUTSIDE

into a compact and highly burnished skin of much greater density than the body of the bar (although a series of scientific experiments have shown that the increased density extends to the centre). By this process the shaft is made much stronger and elastic, the increase in strength being claimed by some investigators as high as 50 per cent. So-called "cold drawn" shafting is made in much the same way as cold rolled, and is considered by some as good as cold rolled.

While the introduction of these special processes in making shafting has resulted in a practical revolution it must not be taken for granted that all shafting going by the name of "cold rolled" or "cold drawn" is reliable or desirable, and only a few makers have succeeded in turning out a reliable product.

The process of

COLD ROLLING

has a tendency to set up internal strains in the metal, and is also liable to "crystallize" the fibre and destroy its tensile strength, and instances are not unknown where shafts which have been broken have shown no grain at all and have failed in much the same way that a brick or clay pipe would break. Any variation in the tension of the rolls during the passage of a shaft through them will cause a slight change in diameter, which will result in bunches or hollows, seriously interfering with the fit of pulleys, if they are all bored to a uniform size

Should a piece of this shaft be cut open for a key-way or "spline," the internal strains above mentioned, if any, are sure to assert themselves and produce a crook or bend, which will prevent its use for anything but very low speed. It is evident, then, from the above that it is not good policy to buy shafting from makers who are not well equipped with apparatus and skilled help for turning out the best work, and who are without reputation or experience in the manufacture of suitable material for the purpose.

STRENGTH OF SHAFTING.

If anyone should take the trouble to go through the manufactories of the country for the express purpose of comparing the sizes of shafts in use for different duties he would be surprised to find the diversity existing among various industries, and, in connection therewith, that mills for the manufacture of cotton goods were running nearer to the limit of strength than any other, while those connected with other industries employ such large factors for safety that a shafting failure is almost unknown. On account of so much difference, the impression is formed that the rules for strength given in the mechanical engineering text-books are unreliable and of little use, which might be true were it not for the fact that actual strength is not the only quality which is needed in a line of shafting to make it perform reliable service and run without excessive friction.

THE TORSIONAL STRENGTH

of a piece of shaft or strength to resist twisting strain is very great, and this property alone is used in nearly all the formulas for computing the proper sizes for certain duties. The transverse strength or stiffness to resist springing is another property which is often overlooked altogether,

or covered only by some stipulation in regard to the distance which bearings should be apart and in which the estimates are always too low.

If a shaft is employed to carry pulleys as well as transmit power, the transverse strength to resist springing should be considered as important as the torsional strength, or the pull of the belts will create a dangerous "cranking" motion by springing the shaft to a certain extent, which wears the bearings and causes unnecessary friction. To fulfill this requirement a diameter somewhat larger than that called for in the books is therefore needed, which adds slightly to the first cost, but pays in the end.

Another important point in respect to small shafting figured for torsional strength alone is that with any means of coupling or fastening the lengths together in the line, splines or keyways must be cut in the ends, and if a small diameter be used the size of the key must also be small, so small, indeed, that it will fail when called upon to stand a strain much less than the shaft itself is able to cope with. An illustration of this kind is known to the writer where a shafting system operating several hundred looms, which was installed several years ago by an ardent advocate of small shafting, has been a continual source of trouble and expense ever since erected, in the way of broken ends and keys, not to mention

THE COSTLY DELAYS

caused by stoppages. In connection with the above case, a comparison of two of the standard formulas for determining the proper size of shafting may serve to demonstrate the necessity for taking into consideration the transverse strength of shafts to resist deflection.

Take, for an example, a line of cold rolled shaft, 100 feet long, carrying pulleys and transmitting 15-horse power at a speed of 250 revolutions per minute. According to the regular accepted formula, the diameter of this shaft should be the cube root of 55 times the horse power divided by the revolutions per minute, which gives 1.48 inches, or practically 1½ inches.

$$d = \text{cube root of } \frac{55 \times \text{H. P.}}{\text{R.}}$$

Assuming that the bearings for this shafting line are 10 feet apart (which is a standard distance), and applying the rule for deflection, which allows for only one one-hundreth of an inch per foot of shaft length when withstanding a 40-pound pull per inch of width of the pulley face, the diameter required in the square root of the cube of the distance between bearings divided by 175, or 2.3 inches (d equals square root of L cubed divided by 175). The great difference in the two results can better be realized when the fact is considered that the torsional strength of the shaft increases as the cube of its diameter.

In the above case the shaft 2.3 inches in diameter, if calculated according to the first formula, would be suitable to transmit 55.3 horsepower, or more than three times as much as was called for, or, to express it concisely, to comply with the regular shafting formula a shaft would be nearly one inch less in diameter than would actually be required to obtain a properly arranged and satisfactory installation.

STANDARD MEASUREMENTS.

Like almost everything manufactured, shafting is bought and sold according to a standard of its own, which is the outcome of long-established custom.

When all shafting was produced from rough iron bars, these bars were either forged or rolled to exact diameters, or as nearly as possible, but in order to finish them in a lathe a chip had to be removed, which reduced this diameter approximately 1-16 of an inch, and instead of calling a shaft by its actual diameter when finished, the full dimension of the rough stock was designated, so that a so-called 2-inch shaft was only 1 15-16 inches, a 2½-inch only 2 7-16 inches, etc. This led by necessity to the designation of the actual sizes in order to fit pulleys and bearings to correspond, and the original custom has been entirely discarded. To add to the complication, many of the shafting makers who em-

ploy other methods than turning the material in the old way have adopted the system of exact size designation and prefer to furnish sizes by quarter inches from one exact inch up, although most of them will, if requested, supply the sixteenth sizes as usual.

It is very important that those who have to do with the specifications for shafting should be conversant with this situation and also to realize the trouble which can be caused by attempting to introduce the new system when buying new shafting to be used with systems already in operation, having dimensions after the old sixteenth standard.

This mistake is often made, and many of the larger mills are reaping the results which cause much expense and delay in case of accident, or when the necessity presents itself for rearrangement of any of the old work and the advantage of interchangeable sizes can be made use of.

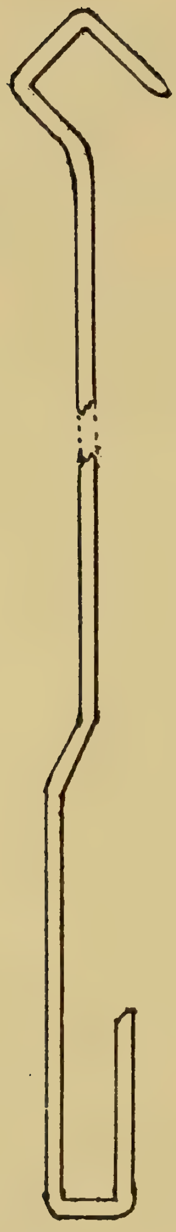


Fig. 2.

Hook Used for Leveling Shafting.

ERECTION OF SHAFTING.

The larger part of new shafting is at the present time erected by contractors, especially if the mill be new and without a mechanical organization.

In starting the erection of a system, the contractor is generally given a basic line to work from, which is taken from the driving units, if in position at the time.

Upon the position and correctness of this line and the fidelity with which the erector follows it depends the satisfactory completion of the entire system, for if started wrong the first deviations are multiplied as every line is added until if the system be a large one the effects will become so serious that the whole equipment will have to be readjusted before it can be operated.

In long lines of shafting which are driven from one end it is customary to reduce the diameters as they recede from the driving point, which gives an excellent opportunity for oversight in erection, for the reason that it is much easier for the erector to place the hangers in position on a line which he determines from the

side of the first few sections in place than to fill in a correct centre line between the basic points given him, and if the decrease in size is slight, as it often is, he is liable to overlook the difference.

AN ACTUAL OCCURRENCE.

Figure 1 illustrates an instance of this nature which actually occurred in a new mill.

The two sections of a large shaft were erected according to the correct line, and as no further guides were furnished by the engineer in charge, the erector proceeded to make them by erecting line B on the line of two line, and the exact conditions were not discovered until it became necessary to realign, some time afterward, when it was found that after putting the main line in the proper place the whole system of receiving shafts had to be moved to correspond with the change, to make the belts run properly on their pulleys.

CARE OF SHAFTING.

Taking it for granted that a new shafting system is installed correctly without any of the defects like that cited above, or other faults traceable to the erectors, the matter of retaining it in good running condition means

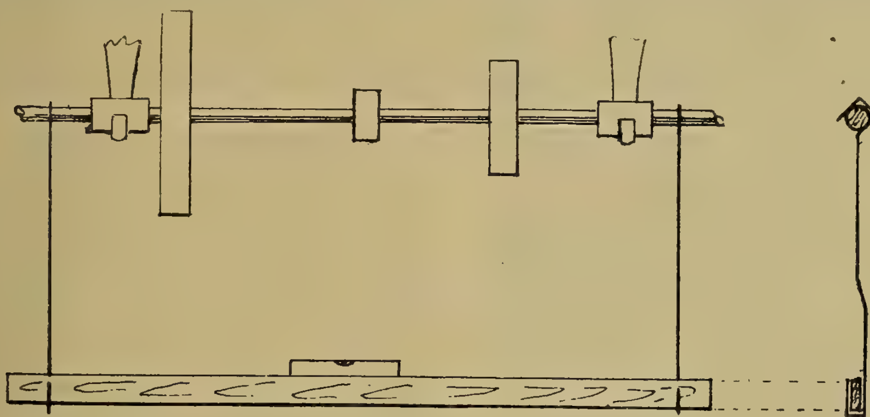


Fig. 3.

Method of Using Hooks and Straight Edge.

points measured from the side of the completed section AA, and using the same distance for locating the side of the new additions, which brought each succeeding section more and more away from the correct centre shown at C. The sketch shows the condition at the end of the first two drops when the deviation amount was sufficient to bring the centre of the last and smaller section one-half its diameter out of the way, as shown. Consequently, when coupled together, the shaft followed a bent line, the "swing" increasing at every reduction in size.

As this shaft drove other lines at different points in its length (some twenty in all), they were erected subsequently to conform with the first a great deal. A great many false impressions are current in regard to the consequences of shafting being slightly out of alignment which were first formed when it was the practice to place all shafting when possible on rigid foundations and in solid immovable boxes. The adoption of the adjustable bearing, capable of a great range of adjustment, as well as allowing a certain amount of elasticity when in operation, has reduced the detrimental results of increased friction in a great measure and also diminished the number of instances where shafting lines are found very badly out of proper position.

Contrary to the general belief, a line of shaft seldom gets out of posi-

tion transversely, except perhaps at local points where the pull of some belt may overcome the power of the bearings to hold it in place, and if once in line it is pretty sure to stay there indefinitely. In respect to vertical adjustment, however, this is not so, and from the time when first put up there are in the ordinary factory building causes at work which are instrumental in throwing a shafting line out of level, and therefore the principal duty to be performed in keeping a system in order is to provide means whereby the lines can be gone over once a year (or more often if the equipment is new), with reasonable dispatch and made as nearly level as possible. The best known and most commonly used devices for leveling is the "straight edge and hooks." The hooks, one of which is shown in Figure 2, are

MADE OF ROUND IRON,

with one end shaped for hanging over the shaft and the other for holding a "straight edge." Pairs of hooks should be provided, having different lengths to suit each particular case, that they may reach down to clear any pulleys on the line and also be short enough to avoid hitting any machinery on the floor below.

In forming these hooks, great care should be taken that the apex of the upper hook is directly in line with the centre of the place formed at the bottom to receive the straight edge, and that all hooks are shaped exactly alike. The notch at the top should have straight sides, as shown, so that it will touch the shaft at only two points.

In use, these hooks are placed upon the shaft, Figure 3, at points which are free from pulleys or couplings and at intervals which may be covered by the straight edge, which should not be less than 10 feet long and carefully made. When the hooks and straight edge are in place, a spirit level laid on top will show the amount the shaft is out of level in the length covered by the two hooks. After adjusting the hanger bearings to correct any deflections which may be found, one hook is moved along to another position and the straight edge passed through. The reading on the level in this position will show the amount the second division is at variance with the first span, and after making the required adjustments, the hooks are moved forward as before, and the operation repeated until the entire line has been covered and leveled.

If the shafts change in size as they extend away from the starting point, the difference can be easily provided for by placing a shim, or "liner," under the end of the straight edge in the hook on the smaller section having a thickness of one-half the difference in the two diameters.

A stock of these shims having the different thicknesses required made of sheet steel should be carried along to

OBVIATE ANY DELAY

or mistakes on account of the change of shaft sizes, which are very numerous in some mills. If the line to be treated is long and driven from one end, it is sometimes found that in order to continue through the entire shaft from the driving point (which is the only proper place from which to start adjustments in any case), and preserve the line called for by the drive or head section that the bearings at the remote end do not have a sufficient range of adjustment. In this case to escape the labor and expense of new bearings or extensive cutting and relocation it is sometimes feasible to change the level of the head line, or, in other words, throw it out of level at a slight distance in favor of the farther end. This slight change, which multiplies rapidly as we advance, will oftentimes be sufficient to accomplish the object, and aside from the extra time taken in going over the line no other expense is incurred.

An immense amount of territory can be covered by two handy men with one of these simple appliances in a short time, and if the lag bolts in hangers are brought up before the adjusting is done and all other bolts in bearings and couplings tightened as well as the set screws in all pul-

leys, one may feel reasonably sure that little or no attention other than the regular routine of the oiling and cleaning need be given the shafting system in any plant. If it is necessary to realign as well as level at the time of general going over, the "calipering" method is very simple and will give correct results. This method has been referred to when speaking of errors in erecting new lines.

The caliper may be made of wood, as shown in Figure 4, with a V-shaped

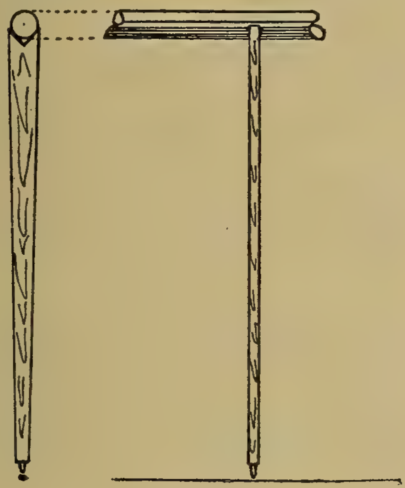


Fig. 4.

A Wooden Caliper.

notch in the larger end. The other end, in the simplest forms, contains a screw with its shank pointed and projecting about one-half an inch from the body of the caliper. A strong line of hemp or linen is strung up parallel to the shaft to be tested at a sufficient distance away to clear all the pulleys, and stretched perfectly tight. The caliper, which must be the proper length to approximately reach from shaft to line,

IS ADJUSTED

to a nicety by turning the screw at the small end either way to bring the length such that when the crotch or V-shaped end is placed against the side of the shaft, the screw end will swing by the line and barely touch it. After once setting, the caliper can be placed along the shaft at different points, and any slight variance from the guide line readily detected. Should the shaft change in size, another caliper set to allow for the difference in diameter may be used, or if, as in some of the more elaborate styles, a standard "inside caliper rod," with screw adjustment, is fitted to the wooden body, instead of the plain screw, the required change can be easily made and only one measure used for all sections.

There are many engineers and millwrights who do not favor appliances of this kind, and claim that the shafting alignment and leveling should be done with an engineer's transit or level.

There are also made several very desirable appliances, for use with a transit or engineer's level, which have met a ready sale. Most of these include a set of hooks, which are so arranged that they may be either suspended from a shaft or erected upon it, and are provided with a colored "target," which can be plainly seen through the instrument. A light is also furnished with some to provide for work in dark places and at night.

While the transit is

ESPECIALLY VALUABLE

for locating new lines for shafting and other construction, as well as for determining angles, etc., it is by no means certain that an operator, however well experienced in the use of the instrument, can be depended upon to give exact readings for the hours of consecutive "sighting" which are necessary in using this method for adjusting shafting on account of excessive strain upon the eyes, which is fatal to correct readings.

Generally speaking, mistakes are fully as apt to occur when work is done with an expensive and delicate instrument as is the case when using the simple spirit level, which anyone can read intelligently and which can cover the work enough faster to allow tours of adjustment more often than with the more refined methods and instruments. There is, therefore, no

valid reason why the condition of the shafting in a plant where the simpler appliances are used by competent persons should not compare favorably with those where the more elaborate methods are employed.

POWER REQUIRED.

There is no proposition concerning mechanics where theory differs from actual practice more than in regard to the amount of power required to drive shafting, or, in other words, the power used in simply turning a transmission system, as compared with the total amount of power expended. The shafting load of any collection of machinery depends largely upon the arrangement of that machinery and the amount of power required per machine. If a certain class of machines using individually a large amount of power can be arranged closely together it is evident that the percentage of power used for shafting will be smaller than another class which consumes less power per unit, and are necessarily scattered so that long lines of shafting are required to carry the power to them. It is plain then the number of horse power required to operate a shafting system for a given set of machinery depends almost wholly upon the amount of horse power consumed by these machines per foot of floor space they occupy. In a textile plant this factor varies greatly, being much larger in the spinning and other departments than in the weaving rooms, and, consequently, we may expect to find a wide difference in the shafting load in comparing the two.

RESULTS RECENTLY OBTAINED.

To illustrate this point the results obtained from several actual tests made to determine the relative load conditions are given as follows:

No. 1—GROUP OF LOOMS DRIVEN BY SINGLE MOTOR.

	h. p.
Power taken by motor and shafting running idle	41.6
Power taken shafting by shafting alone	30
Power taken with full load	195
Shafting load per cent	15.3

No. 2—GROUP OF LOOMS DRIVEN BY SINGLE MOTOR.

	h. p.
Motor and shafting	53
Shafting	42
Full load	212
Shafting load, per cent	19
Average shafting load for the two groups, per cent	17.1

No. 3—GROUP OF RING SPINNING FRAMES DRIVEN BY SINGLE MOTOR.

	h. p.
Motor and shafting	28.6
Shafting	17.5
Full load	237.5
Shafting load per cent	11.6

No. 4—GROUP OF RING SPINNING FRAMES DRIVEN BY SINGLE MOTOR.

	h. p.
Motor and shafting	23.4
Shafting	16
Full load	154
Shafting load per cent	10.3
Average shafting load for the two groups	10.4

No. 5—GROUP OF PICKERS DRIVEN BY SINGLE MOTOR.

	h. p.
Motor and shafting	13
Shafting	8
Full load	120
Shafting load, per cent	.066
Average shafting load for the five tests	9.15

If the above groups were driven by an entire shafting system instead of by motors, the main lines from the prime mover would consume additional power that should not be over 5 per cent, which, added to the 9.15 per cent already obtained, would give 14.15 per cent for the aggregate shafting load.

The much agitated subject which concerns the comparative merits of the mechanical and motor system of driving will not be discussed, as the question is a very broad one. It is, however, certain that the amount of power consumed by a well-designed shafting system, when kept in good operating condition, is much less than many would have us believe, and, furthermore, it is an open question which will have to be decided later when means for correct deductions may be available through the introduction of what is known as "individual motor driving," whether the value of shafting and pulleys does not offset in a measure the expense for the power to operate them by serving as a balance or power reservoir to even out the irregularities always present in working machinery.

The several groups of shafting which are referred to in the foregoing tests were all equipped with the standard style of "ring oiling" bearing, which has been generally considered as good as anything made.

Within the past few years, however, several competitors have made their appearance, which in their construction employ the moving body principle instead of a stationary bearing of frictionless metal, as in the regular style. The earliest of these were made up with two "cages," containing steel balls, which carried the weight of the shaft and were enclosed in a case of about the same length as the ordinary bearing. This style of bearing has proved very efficient, and is used quite extensively, although rather expensive to install, on account of its complicated construction.

Another type employs cylinders instead of balls for the carrying element, and to avoid injury to the shaft by direct contact with the hardened steel carriers, a steel sleeve, closely fitting the shaft and revolving with it, is provided to take the wear.

By employing cylinders, a

LARGE BEARING SURFACE

is obtained with small cylinder diameters, and the mechanism can be placed in a case which will readily go in the place of the ordinary stationary bearing and thus enable a user to retain his old hangers or stands and realize the benefit of an improved bearing with little labor and expense when compared with an entire change of equipment, as is necessary with many of the other types.

The amount of power saved by the installation of any of these high-grade bearings is no doubt considerable, and claims are made by those interested in their adoption ranging from 30 to 70 per cent.

The advisability of adopting these bearings in any case depends upon several things, among which are the cost of power in the locality, the amount of power used as compared with the shafting load, the actual shafting load under existing conditions, the saving reasonably expected, and the cost of the new equipment. Applying these considerations to the shafting system referred to as No. 4 in test reports we obtain the following:

Number of bearings	28
Shafting load	16 h. p.
Assumed cost of power per horse power hour	¾c.
Assumed number of hours operated per year	2,800
Assumed cost of new equipment	$300.00
Assumed interest and depreciation on above cost (12%)	$36.00
Present cost of power to run shafting per year	$336.00
Saving in power required to offset expense of change	10.71%

APPLYING TO GROUP NO. 1.

Number of bearings	130
Shafting load	30 h. p.
Proportionate cost of new equipment	$1,000.00
Interest and depreciation	$120.00
Present cost of power for shafting	$630.00
Necessary saving, per cent	19.04

It should be borne in mind that these estimates

ARE ONLY ASSUMPTIONS,

which are not offered as correct, and that in most cases the actual facts concerning the cost of power, cost of new equipment and existing shafting load may disagree with those cited to the extent that radically different deductions will result. It will behoove anyone, therefore, who considers going to much expense in adopting any of the so-called frictionless bearings to go into the matter very carefully before making a decision.

Mill Construction

AND POWER

Tests Made in a Rhode Island Mill

It is absurd to keep records of coal burned, water evaporated in the boiler, oil used and others of a similar nature, unless this is done accurately. It is where these are made out largely by guess and then carried out three or four decimal places in connection with subsequent cost calculation that they become worse than useless.

We have at hand a detailed report of two tests made upon the steam plant of a Rhode Island textile mill engaged in the manufacture of both cotton and woolen dress goods. Without considering all of the data which was obtained by these tests, we will outline some of the essential points in order to call attention to the value of making such studies occasionally, and also as an example of actual conditions found in a typical steam-driven mill which has been kept well up to date.

The mill has over 31,000 worsted spindles, about 4,000 cotton spindles and 2,500 looms. The boiler plant consists of three Babcock & Wilcox water tube boilers and two vertical, straight shell boilers. The water tube units have 108 four-inch tubes, 18 feet long, and two drums, each 42 inches in diameter. The water tube boilers have a grate surface of 134.6 square feet and the vertical units 66.36 square feet, making a total grate surface of 201 square feet. The three Babcock & Wilcox boilers, are equipped with steam super heaters.

The engine room contains a Corliss cross compound engine, running at 65 revolutions per minute, and the exhaust steam from this unit is used for driving a low-pressure steam turbine, and an auxiliary engine which is directly connected to a combined wet and dry air pump on one side and a centrifugal pump for circulating water on the other. The low-pressure turbine runs at 3,600 revolutions per minute and the small auxiliary engine is driven at 208 revolutions per minute. There is also a steam-driven air compressor, and the exhaust from these auxiliary units passes into the first receiver.

Average Steam Pressures

The two tests were conducted along similar lines, the same number of readings being taken in each case. These readings were taken continuously over a period of ten hours for each test. A summary of the first test is given somewhat in detail, and a few of these results are compared with those obtained during the second test.

The steam pressure was recorded at the boilers, at the engine, at the first receiver, second receiver (or turbine line), and at the inlet of the turbine. The vacuum in the condenser was recorded, also the chimney draft, the draft in the ash pit and the draft over the fire in the furnace. The following table gives the average pressures at these various points during the first tests, which we will designate as run number one.

TABLE NO. 1—AVERAGE PRESSURES.

Steam pressure at boiler by gauge	121 lbs.
Steam pressure at engine by gauge	119.13 lbs.
Steam pressure at first receiver by gauge	17.6 lbs.
Steam pressure at second receiver by gauge (or turbine line)	[illegible]-in. Vac.
Steam pressure at inlet of turbine	5.4 in. Vac.
Vacuum in condenser	28.3 in.
Draft in chimney	.38 in. of water
Draft in ash-pit	.382 in. of water
Draft over the fire in furnace	.175 in. of water

Temperature Readings

Temperature readings were taken as follows: The steam leaving the boilers, the steam at throttle of engine, the outside atmosphere, the circulating water, the flue gases entering the economizer, the flue gases leaving the

economizer, the steam and turbine line, and the feed water, both at entrance and delivery of the economizer. The temperature due to steam pressure was recorded and the degrees of superheat at the throttle calculated. Table No 2 shows the averages for these various items:

TABLE NO. 2.—AVERAGE TEMPERATURES.

Temperature of steam leaving boilers	387.6 deg. F.
Temperature of steam at throttle of engine	373.4 deg. F.
Temperature due to steam pressure	350.8 deg. F.
Degrees of superheat at throttle	22.6 deg. F.
Degrees of outside atmosphere: Average during day	48.2 deg. F.
Temperature of outside atmosphere: Average during the night:	
Temperature of circulating water	53.4 deg. F.
Temperature of flue gases entering the economizer	523.4 deg. F.
Temperature of flue gases leaving the economizer	307 deg. F.
Temperature of feed water entering the economizer	168.5 deg. F.
Temperature of feed water leaving the economizer and entering the boilers	226.7 deg. F.

It will be seen from Table No. 2 that the test shows an average drop in steam temperature between the boilers and the engine of 14.2 degrees Fahrenheit, and it will also be noticed that the use of superheaters gave 22.6 degrees of superheat The feed water was raised from 168.5 degrees Fahrenheit to 226.7, an increase of 58.2 degrees by the use of a fuel economizer. In heating this water, the flue gases were cooled from 523.4 degrees Fahrenheit to 307 degrees Fahrenheit, a drop of 216.4.

Coal Used

A mixture of buckwheat and soft coal was used, containing 37.85 per cent buckwheat and 62.15 soft. The fuel used during the night for heating, manufacturing, etc., was kept separate, and the amount fired during the day was 23,124 pounds of soft coal and 14,071 pounds of buckwheat, making a total of 37,195 pounds. The moisture tests showed 1½ per cent for the soft coal and 2 per cent for the buckwheat, so that the total dry coal burned during the day was 36,577 pounds.

The heat value of each grade of coal and also of the mixture was tested and found to be as follows:

TABLE NO. 3.—SHOWING HEAT VALUE OF FUEL.

Fuel tested.	Heat value in British thermal units.
Buckwheat coal	11,778
Soft coal	14,373
Mixture of above	13,391

As the day test lasted ten hours, the amount of coal used per hour as fired was 3,719.7 pounds. The dry coal used per hour was 3,657.7 pounds and the dry coal used per square foot of grate surface per hour was 18.19 pounds. The ash and refuse removed weighed 4,630 pounds, so that the total pounds of dry combustible used was 31,947 or 3,194.7 per hour.

TABLE NO. 4.—WATER.

Total water evaporated, corrected for leaks, inequality of water level and steam pressure at beginning and end of test	360,195.725	lbs.
Water evaporated actual per hour	36,019.57	lbs.
Water evaporated actual per hour per pound of per hour per pound of coal, as fired	9.68	lbs.
Factor of evaporation	1.0095	lbs.
Total water evaporated, equivalent from and at 212 deg. F.	396,035.20	lbs.
Total water evaporated, equivalent from and at 212 deg. F. per hour	39,603.52	lbs.
Water evaporated, equivalent from and at 212 deg. F. per pound of dry coal.	10.82	lbs.
Water evaporated, equivalent from and at 212 deg. F. per pound of dry combustible	12.39	lbs.

(Not corrected for the quality of steam.)

Water Evaporated

Table No. 4 shows the total water evaporated, water evaporated per hour and the equivalent from and at 212 degrees Fahrenheit for the total water, the water per hour, the water per pound of dry coal and the water per pound of dry combustible. The heat required to evaporate one pound of water depends upon the temperature of the feed water, the pressure of the steam and the quality of the steam, that is, the per cent of moisture. The figures in Table No. 4 have not been corrected for the quality of the steam.

In order that evaporative tests may be satisfactorily compared, it is customary to calculate the equivalent

evaporation from and at 212 degrees Fahrenheit, as indicated in Table No. 4, and this equivalent evaporation may be obtained by the use of the following formula:

$$\text{Equivalent evaporation} = \frac{w\,(x\,r + a - b)}{965.8}$$

where r represents the heat of vaporization at the pressure of the steam in the boiler, a the heat of the liquid at that pressure, b the heat of the liquid at the temperature at the feed water, w the pounds of water evaporated per pound of coal, and x the part of a pound of steam which is dry steam.

Boiler Horse Power

The boiler horse power developed per 34.5 pounds of water from and at 212 degrees Fahrenheit was 1,147.92, and the boiler horse power actually used by the engines was 619.76. The efficiency of the boiler was calculated by dividing the heat absorbed by the boiler per pound of combustible, by the heat value in one pound of combustible, and the results of the first test gave an efficiency of 81.57 per cent. The efficiency of the boiler and grate was determined by dividing the heat absorbed by the boiler per pound of dry coal by the heat in one pound of dry coal, and data taken during the first run gave this efficiency as 78.00.

The soft coal used by this mill costs, delivered in the boiler room, $4.02 per ton of 2,240 pounds. The buckwheat coal, delivered in the boiler room, costs $2.65 per ton of 2,240 pounds, thus making the mixture that was used cost $3.50 per long ton. During run No. 1 the cost of fuel to evaporate 1,000 pounds of water was 16.14 cents, and the equivalent from and at 212 degrees Fahrenheit figures 14.43 cents.

Load on Engines

The cross compound engine has a high pressure cylinder 24½ inches in diameter and a low pressure cylinder 52 inches in diameter. The average output of this unit, as obtained by indicator diagrams, was 1,113.40-horse power. The output of the low pressure steam turbine was obtained from a recording wattmeter connected with the electric generator driven by the turbine. The average combined output of the cross compound engine, the low pressure turbine, the small engine driving the wet and dry air pump, and the steam-driven air compressor was 1,995.20-horse power.

To determine the amount of water used by the engines, the total water from the condenser was measured in tanks, and the water from the separator and that leaking from the stuffing boxes on the air pump was also collected and weighed. There was 210,803.10 pounds of water collected in the measuring tanks from the condenser, 3,356.32 pounds from the separator tank, and 6,270 pounds of leakage from stuffing boxes. This gave as the total water used by the engines 220,429.42 pounds. To cover possible leakage into the condenser, an allowance of 3 per cent was made, bringing the amount of water actually used by the engine down to 21,381.65. Dividing this figure by the total indicated horse power of the engine (1,995.20) gave 10.71 pounds of steam used per indicated horse power per hour.

Table No. 5 shows a few interesting comparisons of results obtained during the first day's test with those for the second run:

TABLE NO. 5.—GIVING COMPARISONS OF THE TWO TESTS.

	Run No. 1.	Run No. 2.
Output of cross compound engine in indicated horse power	1,113.40	1,135.44
Output of low pressure turbine in indicated horse power	810.00	818.00
Steam used by engines per indicated horse power per hour (pounds)	10.71	10.84
Coals used per hour as fired (pounds)	3,719.7	4,024.2
Dry coal used per hour (pounds)	3,657.7	3,838.4
Dry coal used per square foot of grate surface per hour (pounds)..........	18.19	19.10

Mill Repairs

Repairing, or, strictly speaking, the matter of replacing parts of machinery and other construction which have been destroyed either by accident or natural wear, while not being the only work which requires the attention of the mechanical department of a mill, constitutes one of the most important branches, and the application of good judgment and energy in connection therewith will make a very appreciable showing.

In the textile industry, as well as all industries which depend upon machinery in motion for their production, anything which causes a stoppage of the machinery system in part or wholly during working hours means a serious loss, and to forestall stoppage, or if such do occur to be able to get things into shape to operate again in the least possible time, is evidently a matter of great importance. Repair work in connection with the transmission systems or power department becomes then

"EMERGENCY" WORK,

and, of course, must receive attention above all the other mechanical duties about the plant. The principal causes for stoppage in a textile mill plant develop from the breakage or failure of some part of the transmission system.

Troubles with the shafting may be caused by several things. In new plants there may have been errors made in providing shafts of sufficient size to do the work expected with a reasonable margin of surplus strength, or a sudden change in the arrangement of machinery may bring an abnormal load onto some certain sections. With new material, furthermore, there is always certain to be portions which have some internal defects. These oftentimes show up in the shape of breakdowns some months or longer after being put into operation.

The continual changing and gradual settlement of any building

ARE A FREQUENT CAUSE

for shaft troubles, either in the form of breakages or hot and ruined bearings. In almost every shafting system the sizes of the different sections as they recede from the driving power are made smaller in diameter and in many partly new or remodeled mills these changes in size are considerable, often as much as one-half an inch at a single drop. The common custom in these cases is to turn the end of the larger shaft down to fit a coupling corresponding to the smaller end, so that a coupling alike at both ends can be used, as shown in Figure 1.

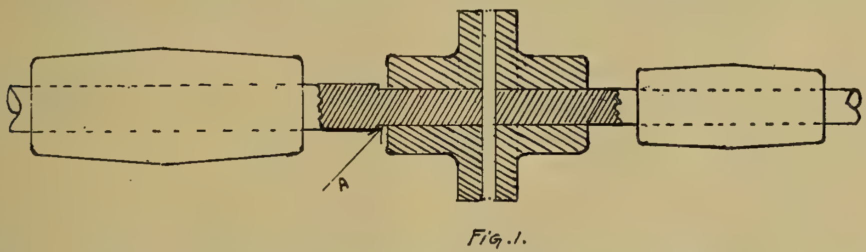


Fig. 1. A Common Method of Arranging Shafting and One to be Avoided.

This operation creates an element of serious trouble, for if (as is sure to be the case) a hanger or bearing is placed reasonably close to the joint on the large side, and a smaller one on the small side, as shown in sketch, and any inequality should arise in the way of alignment or close adjustment which would permit a crank-

ing motion to develop, the greatest strain would come upon the cross section of the larger shaft where it is abruptly reduced in size (at A in sketch) on account of the great rigidity of the larger section which would throw all the fibre movement

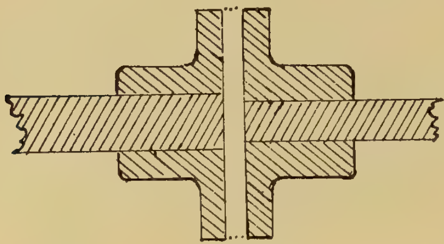


Fig. 2.

Fig. 2. The Proper Method of Using Couplings.

to this point. This strain, if excessive for any reason, is almost sure to bring about a failure sooner or later. To avoid liabilities of this kind, couplings should be provided which allow the full size of shaft at both ends, as shown in Figure 2, where the hub is bored, to fit the full size of the larger shaft, making the whole

CONSTRUCTION MORE ELASTIC,

which will do away with 90 per cent of the shafting failures of this kind.

If, in case of a breakage, it should be impossible or inadvisable to change the size of a coupling, as suggested, an improvement can be made by turning the shaft down gradually, or making a taper (Figure 3) as long as is possible, instead of the abrupt shoulder shown in Figure 1. This relieves the small end of much of the strain by distributing it back toward the body of the larger diameter, and thus increases the elasticity of the whole section.

Shafting failures which occur near some pulley that is fastened on the shaft by a key are illustrations of the same principle. Figure 4 shows a pulley thus placed upon a shaft, where the weakening effect caused by the key way or spline combined with the rigid hold or "bite" of the pulley under a heavy belt strain tends to bring the maximum strain upon the point A, which is usually the place the shaft breaks.

The practical way to eliminate happenings of this kind is to

INCREASE THE SIZE

of the shaft throughout its length, or to procure a shaft with a large section or boss for carrying the pulley which can allow for the key way being cut, and leave a solid diameter equal to the regular size of shaft. (Figure 5.)

Trouble from the standard flange couplings, as shown in the sketches, is seldom experienced if they are fitted properly to the shaft, and when made according to the standard practice are usually the strongest link in the chain of transmission.

The extreme unhandiness of these couplings when it is necessary to remove pulleys, or make other changes, and the expense of fitting them to each particular place has led to the adoption of various forms of so-called improved couplings, many of which are of positively little use for the high duty required in a textile mill. The chief difficulty with most of these couplings is that they cannot be depended upon to stay in place, the gripping power not being sufficient to

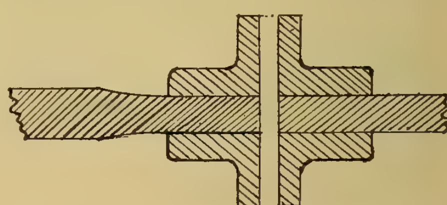


Fig. 3.

Fig. 3. One Way of Avoiding the Arrangement Illustrated by Fig. 1.

hold the shaft ends from working out entirely, or enough to cause them to run badly out of true. Figure 6 shows one of the very few of these couplings which, by its peculiar construction, provides an opportunity to prevent any endwise movement of the shafts, and, on the whole, is a very

reliable and satisfactory appliance. The coupling consists of two halves (AA) which, when placed on the shaft, are held together by the collars (BB) and are screwed onto them, the key slots, both in the shafts and in the sleeve, being cut diagonally, as shown, so that the key when in place lies in a slanting position with the high point toward the joint in shafting. It is evident that this position of the key absolutely prevents any pulling out, and when put together properly, a permanent job is assured. Attention might be called to the fact that this method of placing keys cannot be followed with any of the "patent" couplings except those which split in halves, and therefore does not apply to those constructed with solid expansive sleeves or cones, which must be slipped over the end of the shafts.

Troubles serious enough to cause a stoppage

SELDOM OCCUR

in connection with hot bearings on a shafting system unless some sudden change or delinquency in the regular routine of lubrication may bring a bearing to the dangerous heating point before anything can be done to relieve it.

For emergency lubrication a mixture of graphite and water, which may be changed to graphite and heavy cylinder oil after the first intense heat is dispelled, will prove very efficient and the writer has known of innumerable cases where a bearing nearly destroyed by melting has been held sufficiently cool to enable it being run until stopping time by the judicious and constant application of the above lubricants.

The pulleys of a transmission system, perhaps, contribute as much toward trouble and difficulty as the shafting itself. In many instances where cast-iron pulleys are used there are frequent cases of their breaking from the shaft when running or "bursting." Such occurrences not only cause the stoppage of some part of the system, but are also a serious menace to life and property. This fact is made use of by all of the advocates of other styles of pulleys as a strong argument for the banishment of the cast-iron pulley from the mills entirely.

There are, no doubt, many of the improved types of pulleys which are truly meritorious, and are giving satisfactory service where they are used, but from present indications, it will be a long time before they can completely supplant the cast-iron article which, if properly designed and made of good material by some concern who knows how to mould and cast them, are as reliable as any type yet presented, and considerably cheaper.

In almost every instance where pulley breakage has been at all serious, the cause can be traced to an overzealous engineer who designed them too light, or to some founder who, in moulding and casting, did not give proper attention to the shape of his patterns or to the prevention of unequal contraction when cooling. In a mill erected some years ago a case of poor design was forcibly illustrated.

A SYSTEM OF TRANSMISSION

was erected to drive some three hundred looms which consisted of a head shaft at one end of the room, and twenty countershafts placed at regular intervals from the main, each driving about fifteen looms, and receiving its power through a pulley three feet in diameter. This plan of distribution necessitated exceptionally long belts, as the extreme distance to which the power was transmitted from the head line was nearly three hundred feet. The pulleys used were designed by a well-known authority and advocate of light pulleys and belts, and, contrary to the wishes of the company making them, they were furnished with very thin rims according to specifications.

After being put into service but a short time elapsed before the failures commenced, pieces of a rim, unable to withstand the hammer-like blows of the belt, would break without warning, and the fragments fly in every direction. After this dangerous experience had been repeated several

times it was decided to change the whole equipment by placing pulleys from the same maker, but with rims nearly twice as thick, in place of those which had not already broken, and no pulley troubles were encountered afterward.

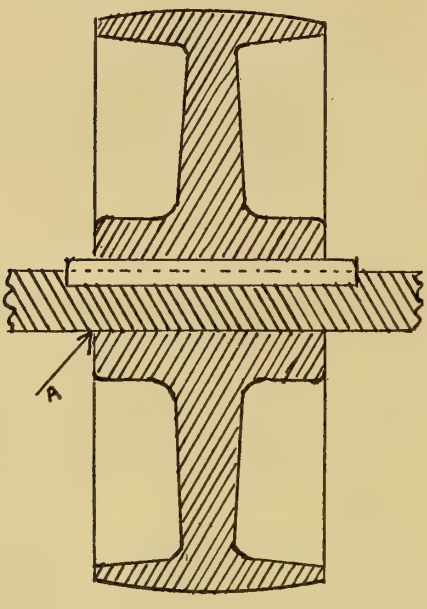


FIG. 4.

Fig. 4. Pulley on Shaft Illustrating the Manner in Which the Key Way Weakens the Shaft Causing a Break at A.

In connection with the subject of pulley making by different foundries, briefly alluded to above, it is doubtful if

THE DIFFERENCE

is generally known between a machine moulded pulley made by a regular company equipped for such business and the product of a small local foundry. In the first-named case the equipment used is costly and complicated, but as large quantities are made, sets of machine patterns for all the regular sizes can be kept on hand, expert workmen who do nothing else can be kept steadily at work, and metal especially adapted to the purpose used. With the small foundry complete patterns of either iron or wood must be had for practically every individual pulley, and if a small shop is fortunate enough to have the size patterns desired the process of hand moulding, added to the uncertain character of the material usually put into common castings, will tend toward producing, at best, a much inferior article to that put out by a regular pulley manufacturer. Aside from the difficulties arising from pulleys breaking, many stoppages are caused by pulleys working loose on the shaft and either refusing to turn at all or moving endwise out of their proper position.

Immunity from this trouble cannot be claimed for any pulley, and the so-called patent styles are certainly

NOT THE MOST RELIABLE

in this respect. The greater part, however, of the cases where pulleys of any kind do not stay in place are brought about by poor fits upon the shaft, and no one not thoroughly realizing the immense twisting and jerking strains brought upon a pulley rapidly revolving under a heavy load can conceive how a pulley, however securely fastened with keys or set screws, or both, can get loose. Neither can they understand how important it is to have the bore of a pulley such that a contact of metal is had over the entire internal surface of the hub, all around the shaft, and not at one or two points only.

FIG. 5.

Figure 5. An Enlarged Section of the Shaft to Prevent the Weak Point Shown by Figure 4.

Stoppages are caused frequently by the belts failing to do their duty in either slipping or breaking, and there is no part of the system which needs so much constant attention as that of the belting, for the reason that no element is undergoing the

same rapid changes. So long as a belt is in use there is a constant stretch going on, that is, the belt is growing longer and thinner, and although these changes are

MUCH MORE APPARENT

when the belt is new, they cannot be ignored at any time of the belt's life, and if one wishes to avoid a shut-down on some morning when the load runs exceptionally hard, he will see to it that the belts are watched and taken up when the first signs of slackness appear. Increasing the normal and regular load of a belt, by starting large groups of machinery too suddenly may cause a belt to break or throw itself off the pulleys, a cause for delay in either case, and judgment should be exercised in "shipping on" machines requiring considerable power, particularly upon cool or damp mornings, or after long periods of idleness, when they are sure to require an unusual amount of power. The mechanics who do the belt repairs should always have at hand, for instant use, rivets and fasteners of various kinds, so that emergency repairs may be made to broken or torn places with as little delay as possible, and should also see that the leather should be kept from getting into a dry condition by the frequent application of some good dressing.

In concluding the remarks concerning defects in the transmission system, it may be in order to add that the difficulties

OCCURRING IN ONE PLANT

cannot be taken as a sample for what is bound to appear in some other, and if it happens that some mills have less trouble than their neighbors it is not always due to better equipment, but to the exercise of foresight and tact on the part of those in active charge, and cases are plenty where a poorly designed and complicated mill is getting along considerably better than a well laid out and finely equipped plant, for the reason that the mechanical department of the one is constantly kept upon its mettle in order to run at all, while with the other, accidents are so infrequent that there is an opportunity and incentive for laxity in looking after matters, and when trouble does occur the men are in no shape to cope with it.

Under the head of general repairs which are not in a sense emergency tasks, we may class the upkeep of the producing machinery, buildings and other mill property, although in the case of the machinery it is very important that the best possible time be made with all repairs which involve any liability of stoppage or delay in pro-

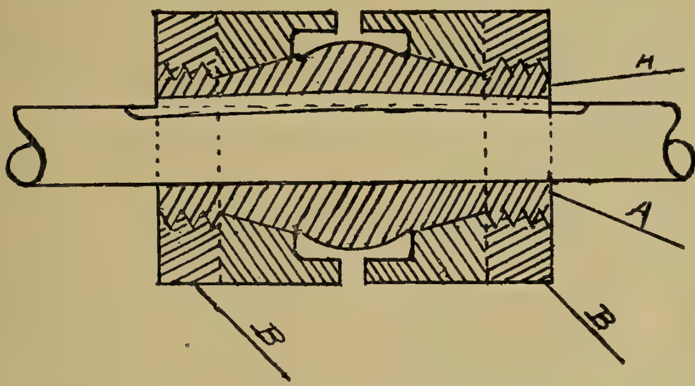


FIG. 6.

Figure 6. A Good, Reliable Special Coupling for Mill Use.

duction. The quantity of duplicate machine parts which should be carried in stock for the purpose of replacing the old or worn-out members with practically no stoppage depends upon the class of machinery in question, and the amount of wear and tear or accidental breakage, and a

GOOD DEAL OF STUDY

should be applied in respect to the proper point to draw the line, and determine whether it is advisable to make up a supply of certain parts, to buy them from the shop where made, how many to carry, or if they are too complicated and expensive to warrant carrying them at all.

In mills where foreign machinery is used, a great deal of delay is nearly always experienced in getting duplicate parts, and, of course, it would be better judgment to provide a larger stock for these machines (unless they be something which can be made at home equally as good) than for those machines made in the vicinity and for which parts can be procured easily.

If the mill is a large one and contains a great number of individual machines which require frequent renewal of parts, like the loom equipment of a cotton mill, it will generally pay to fit up the mill machine shop in such a way that most of them can be produced there, as the machine companies usually calculate on a running expense and profit when making the prices for repair parts, which a mill shop does not have to carry. Consequently, a saving can be made over the manufacturer's price, which, added to the advantage of quicker service, makes an attractive argument along economical lines.

The repairs upon machinery not legitimate or caused by accidents are the

MOST DIFFICULT TO HANDLE

of all, and some chances must be taken in regard to them, for it would certainly be poor policy to endeavor to carry on hand parts which seldom break, except by accident, while, on the other hand, there is a "penny-wise and pound-foolish" proposition in allowing expensive machinery to stand idle for weeks waiting for parts, as is done by some mill managers to avoid tying up a few dollars in duplicates which may not be immediately required.

In putting any new plants into operation many imperfections and weaknesses are sure to appear in all branches of the equipment. In many cases these defects lead to delays, and other serious conditions which can only be met by prompt action on the part of the mechanical force. Upon these occasions for emergency work the only object which can be thought of for the time being is to get things going again as soon as possible, and there is generally no opportunity to improve the construction or arrangement at that time. This state of affairs should not, however,

BE ALLOWED TO CONTINUE

any longer than can be helped, for if a part has broken or failed, and has been replaced by another of the same strength, the breakage is liable to occur again at any moment, and no advance is made toward the goal of successful and continuous operation.

It therefore behooves the mechanic in charge of any plant, new or old, to constantly have in mind the idea that whenever a break of any description occurs it is caused by a defect somewhere, and that if repaired without some change for the better the same conditions exist as before the accident and no gain is made. Mills in which this progressive idea is ignored, may be cited where the troubles are as great and numerous as when the plant was passing through its first years of existence, and, on the other hand, illustrations are plenty of those where the causes leading to every breakdown or accident have been studied out, and improvements made for their elimination, and which are now running practically without any call for hurry or emergency work. The matter of thoroughness in mechanical work pertaining to repairs is one concerning which there cannot be too much said.

As a general rule the mechanical force of a manufacturing plant is

NOT MADE UP OF MEN

who are accustomed to accuracy or disposed to take much pains in doing a job. The result is that a great amount of inferior work is encountered in all branches of industry, but more particularly with the textile trade. There seems to be no sensible reason for this, but the fact remains, nevertheless, and no one in charge can put his energy to better use than in continually following the general run of repairs and see to it that proper attention is paid to thoroughness, and that everything when fixed is fixed to stay beyond any "reasonable doubt." If this policy is pursued, every job done right is out of the way for all time, and the conditions of equipment advanced one step toward perfection, while the energies of the mechanical force can be devoted to other duties tending toward further improvement.

In the replacement of parts to machinery or in adding attachments

IT IS JUST AS IMPORTANT,

if satisfactory results are expected, that every fit be made accurate, as it was so deemed in the shop where the machinery was built, although it is not realized by the crew of the average mill machine shop, and anything that will come within bounds is allowed to go, with the result that repairs do not last, and breakages and delays increase in frequency.

Lack of attention to simple details in the way of securely fastening the different parts of machines, or in properly assembling, is a very expensive feature in many mills. Among mechanics who are constantly at work on machinery and taking out or replacing bolts, pins, nuts, set screws, etc., there is a tendency to overlook the consequences of any of these parts getting loose, or any other failure after the machine is put in operation and left in the care of some unskilled or careless person who has no conception of mechanics. The idea should be corrected, and the men made to consider that, even though it appears absurd to them, such trivial things as nuts and screws working loose or small parts getting out of adjustment may lead to expensive delays and much time wasted on the part of the operatives, and a lot of extra work and travel for those who do the repairing.

There are to-day upon the market, and in successful operation,

THOUSANDS OF MACHINES

which are built for continuous service, that is, they are employed in lines of work where any stoppage or trouble means enormous expense in the way of wasted time and other inconveniences.

Engines for operating electric lights, hoisting and conveying machinery, ventilating machinery and appliances for blowing and producing mechanical draft, are a few of this class, and the builders of such, realizing the exacting conditions under which their machines have to work, have adopted distinctive methods of construction for insuring against occurrences of the nature mentioned which might be well copied by those having to do with the manufacture and repairs of textile equipment. These improvements consist in part of larger bearing surfaces for the running parts, self-oiling boxes protected from dirt by close fitting enclosures, removable bushings which

take the wear and which can be replaced at slight cost, bolts and set screws provided with locknuts or some fastener to prevent their becoming loose, adjustments made with self-locking devices to prevent their being tampered with, and many others.

Mill Construction
AND POWER

Power Cost Wanted.

Winston-Salem, N. C., May 20, 1912.
ED. AMERICAN WOOL & COTTON REPORTER:
At one cent per kilowatt hour, what should our power cost amount to per week of 60 hours, operating the following machinery:

One 40" Opener, " Breaker, " Intermediate, " Finisher lapper — total 4 beaters.

18—40" cards.
36—Heads drawing.
120—12"x6" slubber spindles.
400—10"x5" intermediate spindles.
1,440—7"x3½" speeder spindles.
7,680—Medium gravity Whitin spindles, 3¼" gauge; no separators.
400—Spooler spindles, 4x6 spool.
3—Globe warpers.
1—Lowell slasher, 7x5 cylinder.
192—40" Stafford Ideal looms.
1—Curtis & Marble stitcher.
1—Curtis & Marble brusher.
1—Folder.
1—250 ton press—Bushnell.

We use 2,300-volt alternating current on one 100-horse power motor, one 75-horse power motor and 8 20-horse power motors, and 550-volt alternating current on 3 5-horse power motors, one 7½-horse power motor and one 15-horse power motor.

We make 64 x 60 38½-inch 5.35 prints. Our motors are installed under the specifications of C. R. Makepeace & Company, Providence, R. I., and should be of the proper power and efficiency, if this concern is up to date. They are made by the General Electric Company. Eight 20-horse power, 2,300-volt motors drive our 32 spinning frames, and on our pickers we have 5-horse power, 550-volt individual motors. Our card room is driven by one 75-horse power, 2,300-volt motor; our spooling, warping and elevator by one 15-horse power, 550-volt motor and our slasher, weaving and cloth room by one 100-horse power, 2,300-volt motor. There are 192 40-inch looms, Ideal. We are very much interested, and feel that our power is costing too much, as it is running about $570 per month. No. 1852.

We are somewhat in doubt as to the type of opener you use, and you do not state the machinery that is driven by the one 7½-horse power motor.

Picker Room

If your opener is a combined machine, that is, an opener and breaker fastened together, it would require something like 7 to 9 horse power, and we are taking it for granted that the 7½-horse power motor is used for one of your machines in the picking and opening department. The opener and opener breaker will together require in the neighborhood of 9-horse power, the intermediate breaker about 4-horse power, and the finisher lapper 4-horse power. This makes a total of 17-horse power for the picker room, and as the machines are driven by individual motors, there is no line shaft friction to be considered.

Where individual motors are used for pickers it is generally advisable to use units of 5-horse power each for the single beater, intermediates or finishers. For two-beater machines 10-horse power motors may be used to advantage for some installations, but frequently a 7½ or 8 horse power motor will give more economical results, and is advisable, provided the initial cost for this size is not placed too high, and provided new parts can be obtained quickly in case of accidents. If a gauge box and condenser is combined with a single beater lapper, about 7½-horse power should be allowed for this machine.

We note that your card room con-

Card Room

tains eighteen 40-inch cards, thirty-six heads of drawing, one-hundred and twenty 12 by 6 inch slubber spindles, and four hundred 10 by 5 inch intermediate spindles. With a production of 480 pounds a week of sixty hours, a revolving flat card making a forty-inch lap will use about three-fourths of one-horse power, and if the production be raised to about 960 pounds per week, each machine will take from 1 to 1¼ horse power. Allowing 1-horse power per card will give 18-horse power for this group of machinery, exclusive of all friction losses in the counter shafts.

In stating the number of heads per drawing, you do not give us the number of deliveries per head. We have assumed, however, that your frames consist of 36 heads, 6 deliveries each, and as drawing frames with ordinary rolls require about one-sixth of one horse power per delivery, we have allowed 36-horse power for the drawing. Slubbers similar to those which you are operating require about 1-horse power for every 45 spindles, therefore, with 120 spindles this would figure 2 7-10-horse power. We will neglect all friction losses until summing the entire power which you use, and will call the amount required for your slubbers 3-horse power. The intermediates will take about 1-horse power for every 55 spindles, and dividing 400 by 55 gives 7.3, which we will call 8-horse power. This gives a total of 65-horse power required to operate the machinery in your card room, and since it is all driven by one motor, we should say that the 75-horse power unit which you have is the best size. Allowing but 10 per cent for friction losses would give this machine a load of 71-horse power, and we imagine that this motor is running at nearly full load.

Spooling and Warping

Your 400 spooler spindles will require approximately 3-horse power, and the 3 warpers about 1-horse power. We do not know the size of the elevator which is driven from this same motor, but imagine that 8-horse power is sufficient to cover this. For the elevator, spooling and warping you, therefore, need 12-horse power, and your 15-horse power motor is the best size.

A Lowell slasher, with 7-foot and 5-foot cylinders requires 3-horse power, and your cloth room machinery, including one Curtis & Marble stitcher, one Curtis & Marble brusher and one folder can be operated with 5-horse power. Your 192 forty-inch Stafford looms will take about one-fourth of a horse power each, that is, 48-horse power would be required to operate all of them, neglecting shafting losses.

Motor Too Large

It would seem as if a 100-horse power motor was too large a unit to operate this last group of machinery. Fifty-eight horse power will handle the slasher, looms and cloth room machinery, and if we should allow 25 per cent for friction loss, this would only bring the total up to 73-horse power. We should advise you to have this motor tested that you may determine just how much power it is delivering, and whether a 75-horse power unit would not answer your purposes more satisfactorily. The only way in which power costs in an electrically driven plant can be kept down to a minimum is by adopting some method of determining at fairly frequent intervals the exact amount of power being taken from each motor. Where several machines are upon one circuit, it is advisable for a mill to either buy or borrow portable testing apparatus for keeping track of just what each motor is doing.

Of course, with a high voltage, such as you are using on some of your motors, and, in fact, even with the 550-volt current, you would need to use portable transformers when

measuring motor loads, and while this testing apparatus will pay for itself many times over in a large mill, smaller concerns can often arrange to borrow necessary equipment from some central power station for a nominal cost. If you do not have in your employ a man who is familiar with the method of testing the output of motors upon high voltage circuits, we would strongly advise you to hire some well-informed engineer who can readily obtain accurate data showing just how much power each group of machinery is taking.

Spinning

We judge that your spinning frames are connected according to the four-frame drive, that is, each one of your 20-horse power motors operates four machines. This arrangement is a very satisfactory one and 20-horse power motors may be the best size. It is possible, however, that your frames may not require more than 15-horse power for each of the eight groups, and if 15-horse power motors running at about full loads will handle the equipment, it is better to use these than to use 20-horse power motors and have them each underloaded. Here, again, we should advise having each one tested that you may know definitely just what you are doing.

All of the figures which we have given are approximately correct for the different classes of machinery, but it is impossible to estimate exactly the power required for machinery in the mill, as so many local conditions affect it. The motor sizes can be estimated pretty closely, but after the motors have been installed and the mill machinery has been operated for a certain length of time, each motor circuit should be measured.

In determining the power required for driving 7,680 spindles, we have assumed that half of them are on filling yarn and half on warp. From the warp about 80 spindles can be driven by 1-horse power, and dividing 3,840 by 80 gives us 48-horse power for the spindles making warp yarn. The filling spindles will not require quite as much power, and we can count upon 90 spindles per horse power for these frames. This would give 43-horse power for the frames at work upon filling yarn, or a total of 91-horse power for all of the spinning spindles.

The Total Power

To sum up, we have 17-horse power for the pickers, 65-horse power for the card room, 58-horse power for the looms, slasher and cloth room machinery, 12-horse power for the spooling, warping and elevator, and 91-horse power for the spinning. This gives a total of 243-horse power which does not include the power to drive all lines and countershafts. If your spinning room is driven by the four-frame method, there are no countershafts to consider in that department, and as your picking machinery is driven by individual motors, the only departments containing countershafts are your card room which is driven by one 75-horse power motor, your spooling and warping which has the 15-horse power motor, and your weaving and cloth room which contains the 100-horse power motor.

From the above figures the card room machinery requires 65-horse power, the spooling and warping group 12-horse power and the weaving and cloth room machinery 58-horse power. This is a total of 155-horse power, divided in such small groups that the friction losses should not be large. We will allow, however, 20 per cent for this, bringing a total for the three groups up to 162-horse power, and the total for the whole mill up to 270-horse power.

Cost of Power

Two hundred and seventy horse power is equivalent to 200 kilowatts, and if all of the machinery is driven 60 hours a week it will require 60 times 200, or 12,000-kilowatt hours. At one cent per kilowatt hour this will cost $120 per week, or $6,000 per year of 50 weeks. This, you will note, is about $70 per month less than the av-

erage cost which you give us, but we would call your attention to the fact that a price of one cent per kilowatt hour, without some other restriction, is somewhat unusual, and it is possible that you may not have considered some other fixed rate, such as a fixed charge covering the maximum amount of power which you are entitled to use.

We, of course, do not know whether there is any such fixed charge or not, but many central power stations make up their bill from several different rates, and sometimes confuse a purchaser by leading him to believe that he is paying only the price which is charged per kilowatt hour. We would not say that the central power stations endeavor purposely to mislead, but the kind of contracts which they issue are often complicated, and manufacturers do not give them sufficient attention to realize that there are other charges in addition to the one for actual power used.

Cost for Electric Power

One method which is common consists in charging a certain price per kilowatt hour, and also charging a lump price for the privilege of drawing a certain maximum amount of power should it be desired. In other words, the central power station claims that if a manufacturer has the privilege of using 1,000-horse power, for example, it is necessary to maintain electric generators capable of furnishing this maximum amount whether the purchaser uses it or not. It is held, therefore, that the manufacturer should pay more for the privilege of using 1,000-horse power than for only 500, because more expensive equipment must be kept in readiness to supply this increased amount.

On the other hand, the large user should be able to obtain a wholesale price, and should be able to purchase his power cheaper than the concern using but a small amount. These two arguments are directly opposed to each other, and one manner of getting around them is to give the large user a lower price per kilowatt hour and a higher charge for the privilege of using a greater amount of power. It is then a case of combining the two rates in order to determine just what the power is really costing per kilowatt or per horse power. Some contracts are made out so that a mill will pay one price per kilowatt hour if it uses any amount under a certain fixed number of kilowatts, and another cheaper price if it goes over this fixed sum. Then again there is generally a clause naming a monthly charge which shall be made even if the consumer does not use any power.

Spinning Room Motors

In using eight motors for driving your spinning frames, it will probably be impracticable for you to use motors which can always be driven at full load, and as we did not add any percentage to our estimated power for covering this point, it is quite possible that our total for the spinning room may be a trifle low. The only way for you to determine this fact will be by making the tests already mentioned and finding out whether a 15-horse power motor can handle your work for which you are now using the 20-horse power units. We think that your 100-horse power machine which is driving the looms, cloth loom and slasher is a larger unit than you need, and if measurements of the actual load upon this motor show that it is fairly well up to its capacity, it will be well for you to go over all of your counter shafting carefully and make sure that your hangers are properly in line.

In some mills where part of the machinery is driven by individual motors and by four-frame drives that eliminate countershafts, the machinery which does require shafting is not watched carefully enough, and is allowed to become wasteful in the use of power. With group drives similar to those you have in connection with your 100-horse power motor, 75-horse power motor and even the 15-horse power unit there are many chances for wasting power. With the number of belts used in even these small

groups there are many opportunities for excess slippage, and slipping belts cost money. The shafting itself can readily get out of line even though the lengths are short, and it is well to have this checked up fairly often and all hangers properly adjusted. If you test each of your motors and find out just how much power each set of machinery is using, you will readily locate any department in which the shafting load is excessive. While the meter is attached to a motor the power required to drive the shafting without machinery should always be recorded, and these readings will show up poor conditions immediately.

Many of the Southern mills have installed electric motors, and manufacturers are, in many instances, getting all of their power from the Southern Power Company, instead of maintaining private plants. In the North, most of the mills which are driven electrically have their machinery arranged for group drives, although some of the installations include departments equipped with individual motors for each machine. The individual motor drive has been applied to the spinning frames in several mills, both in the North and South, and there has been considerable discussion as to whether this system is as good a one as some modification of the group drive.

Individual Motors

About a year ago, a series of tests were made comparing spinning rooms using the individual drive with a spinning room of the Cannon Mills, of Concord, N. C., using the group drive. Figure 139 shows a few of the spinning frames at the Kannapolis Mills, at North Carolina, which are driven by the small individual motors. The tests made to compare the two systems were carried on simultaneously, in order that the weather conditions might be the same. The time covered by the test was one week, and both mills were using the same make of spinning frame, and producing yarn of the same count from the same grade of cotton. The tests were made by a competent engineer, and every detail was checked by the operating forces of the mill.

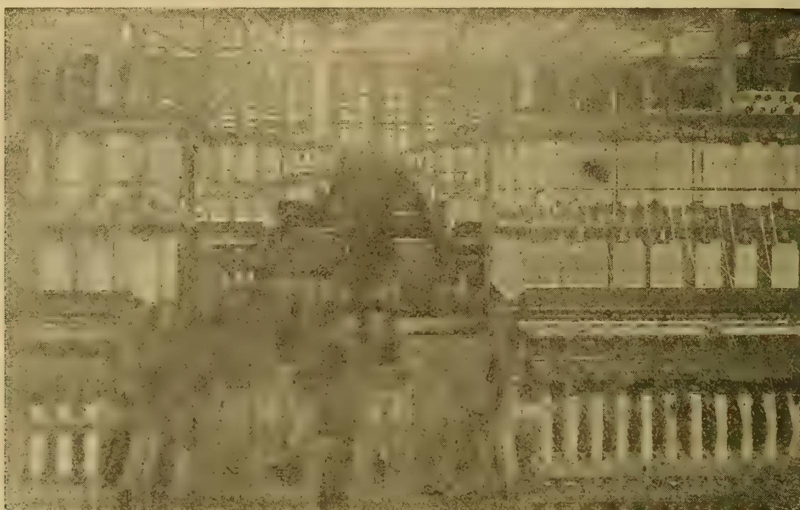


Fig. 139. Spinning Frames Driven by Individual Motors, Kannapolis Mills, North Carolina.

The frames which were driven by the direct connected individual mo-

tors, as indicated by Figure 139, showed a 12 per cent increase in production over the machines which were driven in groups. These individually driven frames also showed an increase in power consumption per pound of yarn of ten per cent. These figures

Production Increased

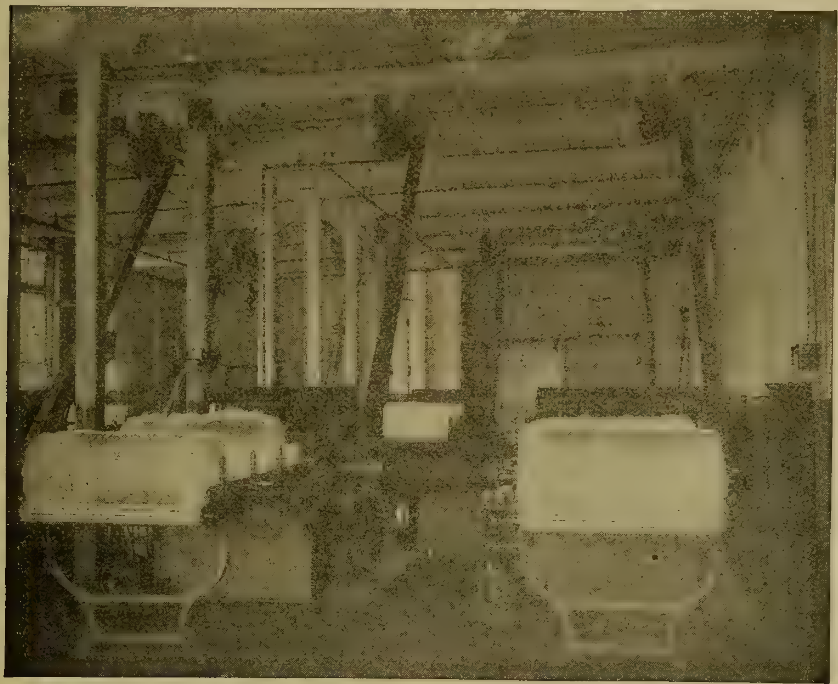


Fig. 140. Picker Room at Kesler Mfg. Co., Salisbury, N. C.

indicate that the power curve of a spinning frame rises faster than the production curve. Nevertheless, in this instance, the value of the increased production was greater than the extra cost of power. It has been stated by some that a large number of small motors would tend to heat the spinning room excessively. Careful tests were made as the two plants above mentioned, and it was found that there was a lower temperature rise with the individual drive than with the group system. For new plants, where there is no old shafting and hangers to be utilized, it is about as cheap to install the individual drives as to arrange equipment for the group method. As a step between the two systems, the four-frame arrangement has been perfected, which, in most instances, has given the best satisfaction in connection with spinning frames. With the four-frame arrangement, one motor having a double pulley on each end operates four frames. This does away with the necessity of using the very small motors, and at the same time does not require the countershafts.

There are several mills in the South under the general direction of J. W. Cannon, of Concord, N. C., which, while not being banded into a corporation, employ a common selling agency, and are essentially one concern from many standpoints. The following table gives a list of these plants, showing their spindleage, the

number of looms in operation and the respective motor capacities:

	Motor capacity in horse power.	Sp'dles.	L'ms.
Amazon Cotton Mills, Thomasville, N. C..	668	5,500	.....
Cabarrus Cotton Mills, Concord, N. C......	1,220	28,000	850
Cannon Mfg. Co., Concord, N. C..........	1,580	30,000	1,000
Cannon Mfg. Co., Kannapolis, N. C......	1,985	32,000	900
Efird Mfg. Co., Albemarle, N. C........	302	25,000	.....
Franklin Cotton Mills, Concord, N. C.......	490	13,000	.....
Gibson Mfg. Co., Concord, N. C.	803	37,000	500
Imperial Cotton Mill, Eatonton, Ga.	....	6,500	150
Kesler Mfg. Co., Salisbury, N. C.........	950	26,000	606
Patterson Mfg. Co., China Grove, N. C..	558	10,000	175
Patterson Mfg. Co., Kannapolis, N. C..	865	20,000	400
Wiscasset Mills Co., Albemarle, N. C....	2,970	65,000	.....
Total	12,386	288,000	4,581

At the Cannon Manufacturing Company, Kannapolis, N. C., there are 125 spinning frames operated by individual electric motors and twelve individual drives in the picking department. The Patterson Manufacturing Company has 88 individually driven spinning frames, and eight individually operated pickers. Both of these mills were originally designed for electric drives. The Kesler Manufacturing Company, of Salisbury, N. C., contains motors with an aggregate capacity of about 1,000-horse power, and drives the pickers with individual motors. Figure 140 is a view of the picker room in this mill, and shows the location of motors. The regular countershaft, which is ordinarily a part of the picking machine's equipment, has been omitted, and each motor is placed at the ceiling.

In the Cabarrus and Wiscasset mills large low voltage motors are used in some of the departments. All motors above 15-horse power that have been installed since the service of the Southern Power Company has been available are designed to operate at 2,200 volts. All motors above 20-horse power are of the wound rotor type, the squirrel cage winding being used only on the small motors.

Purchasing Equipment

In a recent reply to an inquiry from one of our subscribers concerning the advisability of installing a gas or oil engine for driving a cotton mill we called especial attention to the importance of purchasing both the gas producer and gas engine from one concern and obtaining a sufficiently detailed guarantee from the builders to protect the purchaser and insure satisfactory results. There are many firms which handle gas engines and do not manufacture the gas producer, but any one of these engine builders will sign contracts covering satisfactory operations of the whole plant. In some instances the mill owner makes grave mistakes in purchasing machinery which must operate in conjunction with other equipment from several different builders. With a good many lines of machinery this is permissible and often advisable, but in a case like that of a gas producer and gas engine, the fact that the mill man buys each from a separate concern means that any trouble in either unit will be claimed by the prospective builders as being due to poor design on the part of the other manufacturer.

200-Horse Power Gas Engine

We have in mind a certain mill where it was decided to install a 200-horse power gas engine, to be operated by producer gas manufactured with an anthracite coal producer. The purchaser spent a good deal of time sending one of his representatives to visit various installations of somewhat similar equipment, and got in touch with many builders of engines and gas producers. After studying the situation with considerable care, this party decided to purchase a gas producer made by a well-known and reputable concern in the West and the engine from one of the largest builders of this kind of machinery in the country. The electric generator was purchased direct from still a third party.

The first difficulty which arose consisted in determining the proper location for the gas producer building in relation to the room in which the engine was to be installed. The manufacturer of the producer claimed that proper results had been obtained with the producer at such and such a distance where a different kind of engine had been used, and felt that no trouble would be met with if this suggested layout was followed. The engine builders stated that the location of the producer house was of no consequence to them, as all they required was a sufficient quantity and the proper quality of gas, regardless of where this came from. These comments were made after the contracts were signed, and it was, therefore, impossible at the very start to pin down either one of these builders and make them guarantee the right kind of results in regard to the relative location of the two units.

Proper Location

As soon as the apparatus had been assembled and the plant started up troubles began. Some days the engine would run fairly satisfactory, some days it refused to go at all, and at still other times about half-load for half a day was all that the mill could obtain, in spite of the fact that experts representing both the engine builders and the producer builders were on the spot. At first this trouble was thought to be caused by poor valve settings, so the engine was shut down and the valves carefully examined. Slight changes were made and once more the plant was tried out. The results were no better, although at times the engine would carry something like three-quarters of its rated capacity.

Placing the Blame

After making several other adjustments upon the engine, and in the meantime the producer people going over their end of the installation in search of anything which would tend to make the flow of gas uneven, the engine builders refused to admit that anything was wrong with the engine, and claimed that all the trouble was caused by poor gas. The producer people had made almost numberless tests of the gas and held that the producers of the same type were giving the best of satisfaction when used with other makes of engines, and that the trouble, therefore, must lie in the engine.

Due to the fact that the mill owner had individual contracts guaranteeing certain results with each of these two builders, it was practically impossible to hold either one of them, as they both claimed that their equipment was all right and that the trouble was with the other company's apparatus. The engineer at the plant considered installing some kind of a gas regulator which would tend to insure a more even flow of gas. This plant was operated upon the suction principle without the use of any gasometer. The producer men seemed in favor of this change, and agreed to furnish one of their regulators without extra cost As soon as the engine builders heard this they refused to guarantee their engine when used in connection with this regulator unless one of their own was used near the engine. This finally led to the installation of two regulators, one in the producer room, about 100 feet away from the engine, and one in the engine room, within about 18 or 20 feet from the inlet valve. Undoubtedly both regulators were all right and properly designed for certain requirements, but after going to the work of installing both of these, the engine could not be depended upon any more than it could at the start.

Many Changes

All these changes and experiments used up considerable time, and the steam engines were so badly overloaded that trouble at that end was a daily expectation. The regulator in the engine room was moved nearer to the engine, a section of the piping between the engine and producer was pulled out and a larger pipe installed, the regulator in the producer room was

changed over and a small fan put in to help blow the gas over. Some of these changes showed improvements, but the expected economy of the plant was not obtained. It was still impossible to carry much more than three-quarters of the rated load.

The facts are not at hand to show just what arrangement was finally made in the way of paying for this apparatus, and in the end a larger producer was installed. This larger machine helped matters considerably, but had the original order for both units been given either to the producer builders or the firm making the gas engines, there would probably have been little or no difficulty in getting the desired results at the start.

It is not our intention to discourage the uses of gas engines in connection with producer plants. Although this trouble referred to occurred but two or three years ago, improvements have been brought out since that time, and, as above stated, we believe that the principal difficulty in this case was that the particular method for producing the gas in the kind of producer used was not the best one for the style of engine which was purchased.

There are plenty of concerns ready to sell engines and gas equipment with a guarantee that insures proper results.

In commenting upon the subject of gas producers, it is well to consider briefly the care of this equipment.

Care of Gas Producers

The producer designed for anthracite coal does not need the attention of skilled labor, but it should be handled by a man who can be trusted and by one who has a generous supply of good common sense. Perhaps one of the most essential requirements, especially with a suction producer, is that the machine be kept thoroughly cleaned. Poke holes are provided for keeping the lining of the gas machine free from clinker, and unless this cleaning is performed regularly and thoroughly, clinker will become so hardened that it is impossible to remove it without breaking the lining and thus causing air leakage. Air leaks will allow the gas to become ignited in the generating machine, thus burning the gas before it has a chance to be taken over to the engine. This is not all the damage that may be caused by a leakage of air, for the producer is not designed to withstand the excessive heat caused when this gas becomes ignited, and if this combustion is allowed for any length of time, the shell will become burned and weakened. There is also a chance for air leaks around the doors which are provided for removing ashes. These doors are designed to be air tight, but unless they are handled with a fair amount of care they will become bent or warped and give trouble.

There have been many improvements brought out in the construction of valves for the gas lines, but at best

Gas Valves

these are liable to give trouble unless handled carefully. In a recent visit at a gas plant where a gas producer was installed, we found the mill operating its electrically driven machinery by city power, due to the fact that a new valve was required and there had been some difficulty in obtaining this promptly from the builders. A point worthy of note in this connection is that the concern always kept an extra valve on hand, knowing from experience that these were liable to give out at any time. In this particular case both the regular and extra valves were out of commission, and the mill's machinist was at work repairing one of these in order that the producer might be started up without waiting for the new one to arrive. On questioning the chief engineer regarding the way in which the valve had become broken, it was found that whenever the attendant had trouble in operating it with the regular handle provided, he was in the habit of putting on a piece of pipe, thus extending the handle some five or six feet and obtaining enough leverage to do one of two things, namely, move the valve or smash it.

No kind of machinery can be made absolutely "fool proof." and the chief engineer, master mechanic, or whoever is in charge of the power department of the mill, should make it a point to prevent these absurd methods which lead to nothing but unnecessary expense. The man who was operating this particular producer was absolutely reliable, was conscientious in his work, and could have readily been taught to use proper care had the chief engineer taken the trouble to give this matter the proper amount of consideration.

Absurd Methods

There are few textile mills where all of the power is furnished by either gas or oil engines. This is largely due to the fact that the textile mill requires large quantities of steam for various manufacturing purposes, and must, therefore, install a boiler plant of considerable size, even if the power is obtained in some other way than from steam engines or turbines. There are a good many plants, however, where increased business makes it necessary to provide additional power, and where this power can be economically obtained by installing a good gas or oil unit. With a machine large enough to develop 200-horse power or more, the speed is sufficiently uniform to drive the mill mechanically. In most cases, however, better results are obtained by connecting the gas or oil engine directly to an alternating current electric generator, and then distributing the power electrically to the various mill departments.

In purchasing mill motors, it is unwise to use any one type of motor to the exclusion of all other makes, without first making sure that the kind used is the best that can be obtained. It is equally unwise, however, to install a lot of different styles, for this complicates matters in making repairs. These statements might seem rather contradictory, but at the present time it is possible to secure reliable engineering advice concerning the action of motors of standard type and thus determine with a large degree of certainty which style is best suited to meet the individual requirements.

Purchasing Motors

Some classes of textile machinery should be driven in fairly large groups some in small groups and some by individual motors. This makes it necessary to use several different sizes, but it is a distinct advantage to keep the number of these sizes as small as possible. By doing this the number of extra machines which should be kept on hand may be small and the expense for repairs kept low.

Some Uses of Compressed Air in the Textile Mill

It can undoubtedly be said with truth that the introduction of the electric motor into the textile mill also marked the introduction to any great extent of compressed air.

When motors were first used in the mills, it was customary to clean them by what was termed "blowing out" with hand bellows. This consisted simply of blowing air through the gap between the stator and rotor of the motor, so as to clean out all dirt and foreign substances which had collected there.

It was found, however,

THAT THE PRESSURE OF AIR

which could be obtained by the use of the bellows was not sufficient to give a good, thorough cleaning, and it was also found difficult for an employe to stand on a ladder and use both hands to operate the bellows when the motor was suspended from the ceiling.

This led to the installation of small air compressors of sufficient capacity

to give a good pressure when the motor was being blown out.

The humidifying of the mills, which has been taken up to such an extent within the last few years, may be attributed as the second reason for the installation of the air compressor. There are a great many types of humidifiers on the market to-day, some of which require compressed air for their operation. While the writer does not intend

TO DISCUSS THE MERITS

of the different types of humidifiers, still he feels inclined to state that he considers the man who has a humidifier operated by compressed air as having the advantage over the one whose humidifier is operated by mechanical means for the following reasons:

Where there are air pipe lines running through the rooms to operate humidifiers, it is an easy matter to tap them at intervals and make connections for hose pipes which can be used for blowing out motors, cleaning off frames or operating pneumatic air tools.

In cleaning frames with compressed air the pressure maintained varies usually for different kinds of machinery. Spinning frames and looms are the frames most commonly cleaned by compressed air, as these two rooms and the card room are the ones in which

HUMIDIFIERS ARE MOST NEEDED.

Compressed air is not so commonly used for cleaning in the card room, as it is liable to break down the sliver web on the cards or the ends of the roving frames if not handled very carefully. For another reason, it is liable to blow lint onto the roving, which would cause slubs in the yarn when being spun.

For cleaning the spinning frames a pressure of 30 pounds has been found sufficient. When cleaning the frames care should be taken to hold the nozzle of the hose downward, so that the lint blown off the frame will fall downward and not be blown onto the bobbins on the opposite side of the frame. It will be found that gears on a spinning frame which would be hard to get at to clean with a brush can be easily cleaned by means of the air.

A pressure of from 50 to 60 pounds has been

FOUND MORE SATISFACTORY

for the cleaning of looms. Underneath the looms a great many of the parts are more or less oily. The lint from the yarn collects on these parts and unless a good pressure of air is used it will be found difficult to give the looms a thorough cleaning.

In order to give an idea of the uses to which pneumatic tools can be put in the mill the writer will give a few specific instances that have come under his observation. The company built a new weave shed in which they installed humidifiers operated by compressed air. There was to be an installation of over 600 looms in this shed, all looms being driven through the floor by shafting in the basement. This meant that over 600 belt holes had to be cut in the floor, which was composed of three layers amounting to 5⅝ inches in thickness. A set of pneumatic tools had recently been purchased, consisting of a wood boring machine, two sizes of air drills, and an air hammer.

TO CUT THESE BELT HOLES

the wood boring machine was brought into use. Bearings were made for it and it was supported by a framework on which it slid up and down and which could be swung backward or forward in the arc of a circle, so that

the desired angle of the belt hole could be obtained. The lines for the front legs of the looms were first struck on the floor. Then at one end of each line a quarter-inch hole was bored through the floor. By going into the basement of the shed the distance was found from the line to the centre of the driving shaft. A drawing was then made accurate to scale, showing the loom pulley in relation to its driving pulley on the shaft below when the loom was in position. By drawing lines representing the belt connecting the two pulleys it was found where the belt would go through the floor and at what degree of angle. In this way the position of the belt holes was determined.

Holes were then bored with the machine, using a two-inch ship auger at the four corners of each belt hole where the belt was crossed and at each end of the belt hole where the belt was a straight one. This left only a little

STOCK FOR THE CARPENTER

to cut away with small saws and chisels to finish the holes.

One has only to see a hole bored at an angle through a 5⅞-inch thick floor by hand, and then see the same process done with a wood-boring machine, to realize the great saving in labor and time that can be accomplished. In the same shed, holes had to be drilled in the loom arches in order to attach brackets for holding filling boxes. These holes were all drilled by means of an air drill.

Another instance can be mentioned, where a shaft which was driven direct from the engine became broken. In order to remove the broken shaft and replace with a new one, it was necessary to loosen the bolts on a split iron shieve six feet in diameter, and about the same in width of face. When it came to loosening the 2½-inch diameter hub bolts it was found that

IT WAS IMPOSSIBLE

to move the nuts, as they had been put on when the bolts were hot. This shieve was supported by an iron framework 50 feet above the floor and working space was limited. As there was a generator on the floor below there was an air pipe for blowing it out. Temporary piping was run from there to the shieve. Holes were first drilled through the nuts and then the air chisel was used to cut between the holes. In this way the nuts were split so that they were readily removed.

In another case an installation of new shafting was made. This required timbers 8 inches by 10 inches, 6 inches by 6 inches, and 3 inches by 8 inches. All of these timbers were bored with the wood boring machine. The holes for the hanger bolts were also bored in the overhead timbers with the machine.

Numerous other instances

CAN ALSO BE GIVEN

of uses of the air which were made in the mill. Horizontal tubular boilers were cleaned, using a tube cleaner operated by air; repairs were made in the boiler room with the air drill and chisel; repairs were made with the air drill on pickers, when it was impossible to take the broken parts to the shop to be repaired. In fact, it was demonstrated that compressed air could be used in almost every department of a textile mill and effect a great saving in time and labor on repair work outside of the benefits derived from the humidifier.

The Belt and Roll Shop

It is undoubtedly a fact that there are few mills to-day but that maintain their own shop for covering rollers and repairing belting. There are so many ways in which such a shop can be used to advantage that any mill will find the installation of such an economical asset.

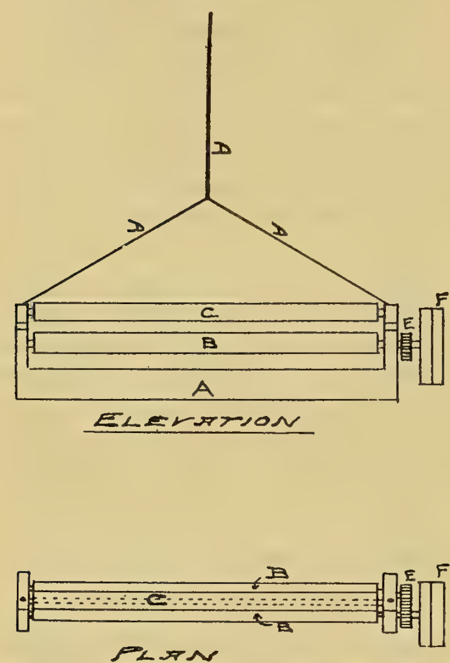


Fig. A-1. The Calender Rolls.

The chief use to which the shop is put is naturally the covering of spinning and card room rollers and maintenance of belting. It is necessary, if it is desired to produce good work, to have all rollers in good condition, and when a bad one is found it should be taken from the frame and a newly-covered one substituted. The overseer should see that too many bad rolls are not collected before being sent down to the roll shop to be recovered, so that there will not have to be any spindles idle on account of waiting for rollers.

In starting to recover rollers, the first thing to do is to cut off the old skins from the rollers. The rollers are then put into a bath of hot water. For this purpose an ordinary iron sink can be used. The water can be run in and heated by having a jet of steam injected into it. After soaking a little while it will be found that the old roller cloth can be removed easily. The rollers should then be scoured well to clean off all the old paste. After drying they are ready for covering with the roller cloth.

THE ROLLER CLOTHS

used by mills vary a great deal, and the mills usually determine what grade they will purchase by the kinds of yarn being spun. In mills spinning fine yarns a cloth is generally used which is manufactured from good wool and weighs from 16 to 20 ounces for a yard, 27 inches wide, the 16-ounce being used for the spinning rollers, and the 20-ounce for the card room rollers. In a mill using as good a grade of cloth as this it is customary for the roller coverer to examine each roller sent down for recovering and determine whether or not the roller cloth has to be removed. This cloth should have a good cushion effect and should outlast several leather coverings or cots before being discarded.

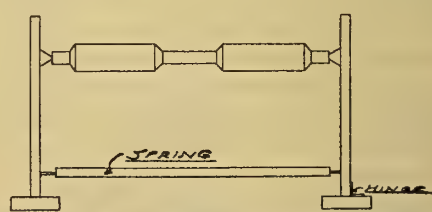
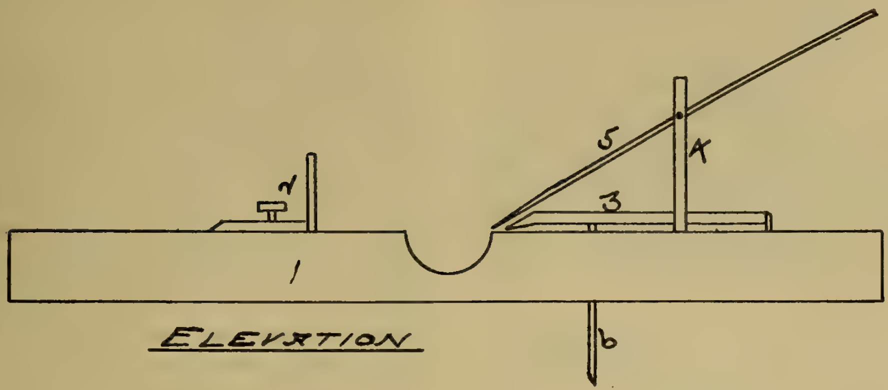


Fig. A. Stand Used When Applying Paste.

In a mill spinning coarse numbers a cloth weighing from 12 to 14 ounces is used, the 12-ounce for the spinning



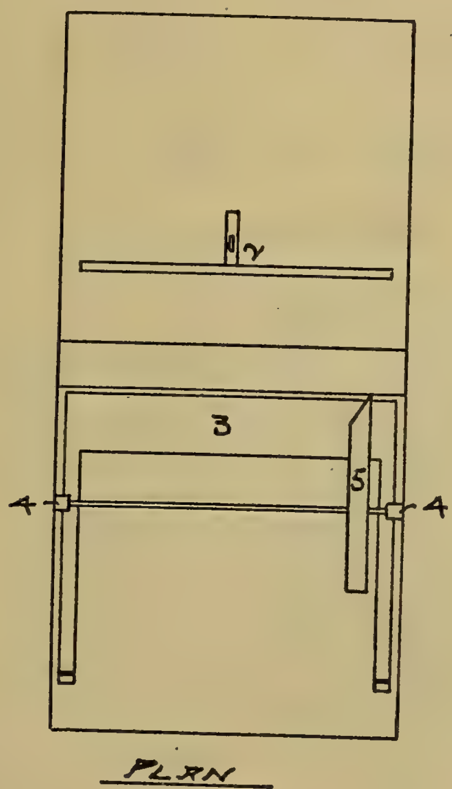


Fig. B. Sciving or Scarfing Machine.

rollers and the 14-ounce for the card room rollers. The cloth is usually composed of

A SHODDY MIXTURE,

and its cushion effect is so slight that it is very rarely fit to use after the leather covering has to be discarded. The best way to do is not to take any chances and remove all cloth of this kind from the rollers before recovering. This cloth, however, is all right for use on this kind of work, as the spinning of coarse numbers is very wearing on rollers, and it would not be economical to use any better grade.

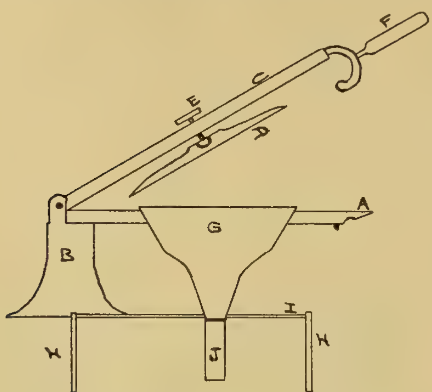


Fig. C. Cementing or Piecing Bar.

The cloth is first cut into long strips the width of the roller to be recovered. It is then cut into lengths just long enough to lap around the roller. In doing this the edges should be cut at a slight bevel, so that they will overlap when put on the rollers, thus avoiding a square joint which would be hard to close up tight and would tend to make an uneven surface. The roller is then inserted in a stand which holds it stationary while the paste is being applied. One of the uprights has a hinge attached so that it may be moved out a little when the roller is being inserted.

THE PASTE.

A sketch of this is shown in Figure A. The spring exerts only enough tension to keep the roller from revolving when being pasted. A paste which gives good satisfaction is composed of one quart of common glue with one-half pint of Venice turpentine added. The turpentine keeps the glue from becoming brittle and cracking when dry. After pasting, the cloth is put around the roller and the roller is then calendered between iron rolls. The calender consists of two iron rolls lying parallel to one another. On the end of each is a gear, these two gears meshing together. One of the rolls has a pulley on the end, which is belted to a countershaft above by means of which the calender receives its motion. A third iron roll is situated so that its centre comes directly over the centre of the space between the two rolls.

This roll is actuated by a foot lever so that it can be raised or lowered. The sketch designated as Figure **A-1** illustrates this. A is the **stand with** bearings supporting **the rolls B, and** E designates the **gears on the ends** of B. F is the pulley on the front roll B. C is the third roll and is raised or lowered by the rope D, which is attached to the foot lever.

THE THIRD ROLL

is raised and the roller with the cloth on it is dropped in the space between the two bottom rolls and resting on them. The third roll is then lowered and its weight is allowed to rest on the roller, and the two bottom rolls being in motion the roller naturally starts to revolve. In this way the cloth and paste are rolled so as to lie evenly and all lumps and thicknesses in the paste are evened out.

Care should be taken to see that the roller is placed in the calender so that it will revolve in the direction of the cloth cap. The calender should be able to hold six or seven rollers at a time. As soon as a roller is covered with cloth it should be put in the calender and one taken from the calender to make room for it. This is usually done systematically by taking out a roller at the right hand end of the machine and inserting one at the left hand end. In this way each roller is sure of being calendered a sufficient length of time. The calender rolls do not have to be heated. After calendering, the rollers are

placed on a rack to dry, which usually takes about two or three hours.

SHEEPSKIN COT.

The rollers are then ready for covering with the cot which is made of sheepskin or calfskin. Some carders believe that calfskin is the best for card room rollers, but it has been found that sheepskin does as well. There are all kinds and qualities of skins, varying in price from seven dollars a dozen up to fourteen or even higher. Manufacturers of fine yarns usually buy the higher priced skins, whereas the coarse yarn manufacturers pay about eight or nine dollars.

The manufacturers should have in charge of this department a man who is honest and a good judge of skins. He should get his opinion on the skins that are bought as to whether they are up to standard. A good skin should be soft and pliable and free from cracks and not too uneven in regard to thickness. It should also be noted how much waste there is in the cutting-up process and how many cots can be cut from one dozen skins against another dozen from a different dealer.

CLOSE OBSERVATION

of skins will show quite a variation in this line. The thickest and strongest part of the skins is along the centre of the back from neck to tail. These parts should be used for the card room rollers and the skin from the sides for the spinning room rollers. In cutting the skins up into strips, it should be cut the length of the skin from the neck to the tail. The strips are then ready for sciving. This consists in cutting the strips into pieces of right length for covering the rollers and in cutting them on an angle so that an even bevelled edge will be obtained for cementing. The sciving or scarfing is done on a machine, a rough sketch of which is given in Figure B. It consists of the main iron base marked (1). On the top of the base is the gauge (2). This gauge can be moved backward or forward, so that the required size cot may be obtained. Number (5) is

THE SCARFING KNIFE.

As can be seen, it is supported on a rod by the uprights (4). Number (3) is the clamp which holds the skin during the cutting. It is attached by two rods (6) to a foot lever. When the foot presses the lever, (No. 3) bears down and holds the skin, when the pressure is released, it rises enough to let the skin pass under easily. The method of operation is this: The strip of sheepskin is passed over the top surface of the base under (3) until it comes to the gauge. The foot now presses the foot lever and (3) presses down on the strip. The operator then takes the knife and with a firm pressure draws it from right to left. As can be seen, the knife is sharpened on an angle. The point just extends over the hollow in the base. By this method an accurate angle is obtained for every piece of leather cut. This process is continued until the necessary pieces for cots are cut, the operator merely easing up on the foot pressure when pushing the strip to the gauge. Pieces for double boss rollers should be cut and cemented as one and then cut almost in two. This insures the

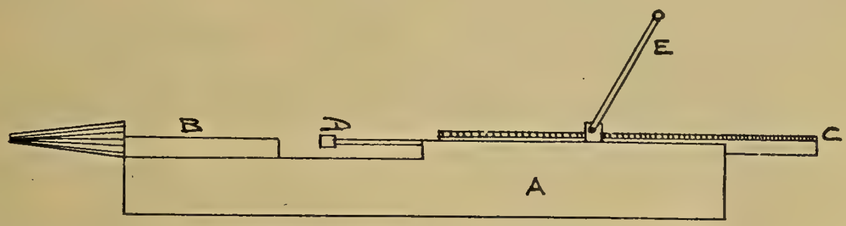


Fig. D. Pushing-on Machine.

roller against having cots of uneven thickness on either roll.

CEMENTING OR PIECING.

The pieces are now ready for cementing or piecing and forming what are called cots. This is done on a cementing or piecing bar, as shown in Figure C. It consists of the straight bar A, fastened to the stand B. The bar C is also fastened to the stand B, and pivoted on a stud, as shown. The bar C carries the small bar D; D is connected to C by means of the thumb screw E, which allows D to be raised or lowered. D is connected to the semi-circular piece of iron which is fastened to the end of the screw E, and is thus allowed to swing in a semi-circle. The handle F is attached to the end of C. As shown, the part attached to C is curved in a half circle and has a rounded piece attached to the other end. G is the iron clamp hinged on an eccentric to the rod I, which is supported by the uprights H. J is a piece of spring steel. One end is fastened to the same stand that B is fastened to. The other end bears against the eccentric on the end of G. The operator takes the piece which he is going to make into a cot, brings it up to the left side of the bar A, and lays it with the glazed or hair side of the skin up, so that the bevel lies in the centre of the top surface of A. He then presses the clamp G down, which holds the piece firmly on A, by means of the pressure exerted by the spring J. The lap is then coated with a thin layer of cement composed of gelatine dissolved in water. Enough gelatine is put in so that the cement will be neither too thick nor too thin.

The pot containing the cement should be kept in hot water so that the cement will not harden. Some coverers prefer alcohol to water, as it tends to make the cement dry more quickly, and others use acetic acid, as it cuts the gelatine better than water does. The other bevel is now brought from under the bar A, up the right hand side and laid on the cemented lap. The operator then pulls on the handle F, bringing down the bar C. This causes D to press down on the cemented lap. The rounded piece on the handle F catches in the notch directly under the end of A, as shown. This allows D to exert pressure on the lap without necessitating holding down on the handle. The pressure is maintained for a few seconds and then the handle is raised and the piece is drawn from A in the shape of a tube. This tube is called the "cot."

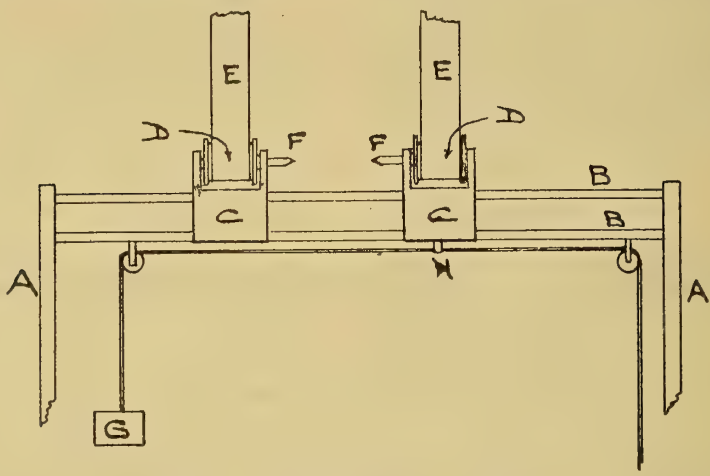


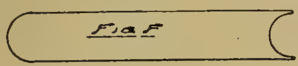
Fig. E. Burning Down Lathe.

IT IS A GOOD IDEA

for the operator to have two of these

machines, so that when a cot is being pressed on one of them he can be making a cot on the other machine.

It is now ready for placing on the roller, which is done either by drawing the cot onto the roller or pushing the roller into the cot. Figure D gives an idea of a pushing-on machine. It consists of the base A, which supports B. B is a brass groove or shell, on the end of which are thin wires in the form of a cone, as shown. C is a casting resting in a groove cut in the top of A. On the end near B is the spindle D, which is fastened to the end of C. On the top of C is a



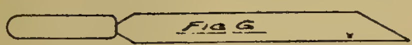


Fig. F. Ending Tool.
Fig. G. Trimming Tool.

row of teeth, as shown. These teeth mesh into a gear which is on a stud, to which the handle E is connected. By turning the handle to right or left the casting C, and consequently the spindle D, can be moved backward and forward. The machine is operated as follows: The cot is drawn over the wires about three-fourths of its length. The roller, which has been covered with cloth, is placed in the shell B. The shell B, with its wire cone, is interchangeable for different sized rollers. The handle E is now turned to the right. This causes the spindle to come in contact with the roller, thus forcing it into and out through the end of the cone of wires. As the roller starts to come from the cone the operator grasps the end of the cot where it begins to cover the roller. Holding this firmly he continues turning the handle E until the roller has been pushed through the cone. In this manner the roller is pushed into the cot. This process should be done with a firm pressure and not too fast so as not to stretch the cot unevenly or split the cemented lap. The drawing-on process is the reverse of this, the cot being drawn onto the roller by means of the wires.

The rollers are now ready for ending or burning down. This consists in turning over the ends of the cot which protrude so as to keep it from slipping when running in the spinning frame. This process is done in the burning down lathe. The principal portion of one is illustrated by Figure E. In this sketch A designates the two lags of the machine. Attached to these lags or sides are the rods B. There are three of these rods designated as B, the third one not being shown, as it lies parallel to the lower rod B, and about 6 inches from it. These rods support the castings C, which act as bearings for the pulleys D. The pulleys D are belted to a countershaft above by means of the belts E. The pulleys have hollow centres, into which the spindles F are inserted, being a taper fit. The casting C, at the right of the illustration, has the

SMALL HOOK I ATTACHED

to it. A chain is fastened and holds the weight G. Another chain runs to the right over a pulley and down to a foot lever not shown.

The operator starts the countershaft moving, which causes the pulleys D to revolve at a speed of about 3,000 revolutions per minute. He then presses down on the foot lever, which causes C to move to the right. He then places one end of the roller to be turned down on the spindle at the left and then releases the pressure on the foot lever gradually. The weight G causes C to move to the left until the spindle F comes in contact with the other end of the roller. The roller is now revolving at the same speed as the pulleys. The operator then takes the ending tool and turns down the cot at each end. Ending tools are made of various substances, but a very good one can be made from a piece of a cigar box. Figure F gives a view of an ending tool. The wood is curved in at one end to fit the roller. The operator should apply the tool just over the edge of the cloth and should push it downward and outward with a firm

pressure, in order to avoid creasing the end. The spare leather at the ends of the cot should be trimmed off. This is done with the tool shown in Figure G, which consists of an old file sharpened and beveled or tapered at the end. The tool is held against the leather and then pushed away from the cot, thus cutting away a small ring of leather. The operator takes his ending tool and inserting it in the ring of leather exerts pressure and thus breaks it away from the roller. The roller is then removed from the lathe by pushing on the foot lever as before and is laid on a rack. When the rack is full the rollers should be marked with ink, showing the direction in which the lap runs. This will enable the spinner to put the roller in the frame so that it will not run against the lap. After counting the rollers, to find the numbers which have been covered, they are ready to go back to the spinning and card rooms.

The drawing frame rollers are covered in a little different manner. Up through the covering of the roller with cloth the

PROCESS IS THE SAME

as for the card and spinning rollers but the covering with leather is different. In the first place, sheepskin is not used for covering these rollers. For this purpose fillet winding leather is generally used. This leather is about one-eighth of an inch in thickness and comes in different widths, $1\frac{1}{2}$ inches being a good width to use. This leather is not made into a cot but is wound onto the roller in a spiral fashion with the aid of the machine shown in Figure H. This machine consists of the bed A, supported by the legs B. At one end of A is the casting C, which supports the spindle D. C is movable along the bed A to accommodate different length rollers. At the other end the casting E supports the spindle F, which has a face plate attached for holding a small lathe dog. On the end of F is the gear G, which meshes into the gear H, of about one-quarter the number of teeth. The handle I is attached to the gear H. On one end of the roller a small dog is fastened. The roller is then placed in the lathe, one end on D and the end with the dog attached on F, thus allowing the dog to come in contact with the face plate. The end of the fillet leather is then glued and wound once around the left end of the roller, allowing the end of the leather to extend a little over the end of the cloth. It is then tied securely to the roller with a string. A portion of the leather is then glued and it is wound on the roller, the operator turning the handle I with his right hand and guiding on the fillet with his left. In this way the fillet is wound on spirally from left to right. When the operator reaches the end at the right he should tie this with string as at the left. The roller is then removed from the lathe and stood on end to dry. The gears G and H should have a locking arrangement, so that they will not tend to revolve, when the operator removes his hand from the handle, at any time during the process of winding. When dry, the

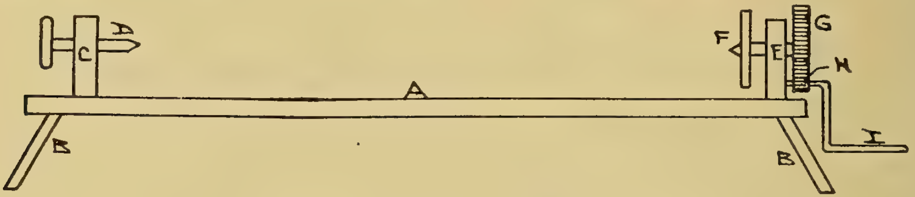


Fig. H. Winding Machine.

ROLLER IS BURNED DOWN

or ended, the same as the spinning rollers.

It is then ready for buffing. This is done to even the leather so that the roller will be of an even diameter

throughout. Figure I shows a buffing machine. It consists of the bed A, supported on legs as shown. At the left end is the casting B, which supports the bearings for the pulleys C and D and also the spindle F. The spindle F has a face plate as shown. O passes around the left end of the bed A, and is attached to a collar on the rod M, as shown by the letter Q. One of the pulleys, C, is belted with a straight belt to its opposite pulley N, and the other pulley C is belted with a cross belt to the other pulley

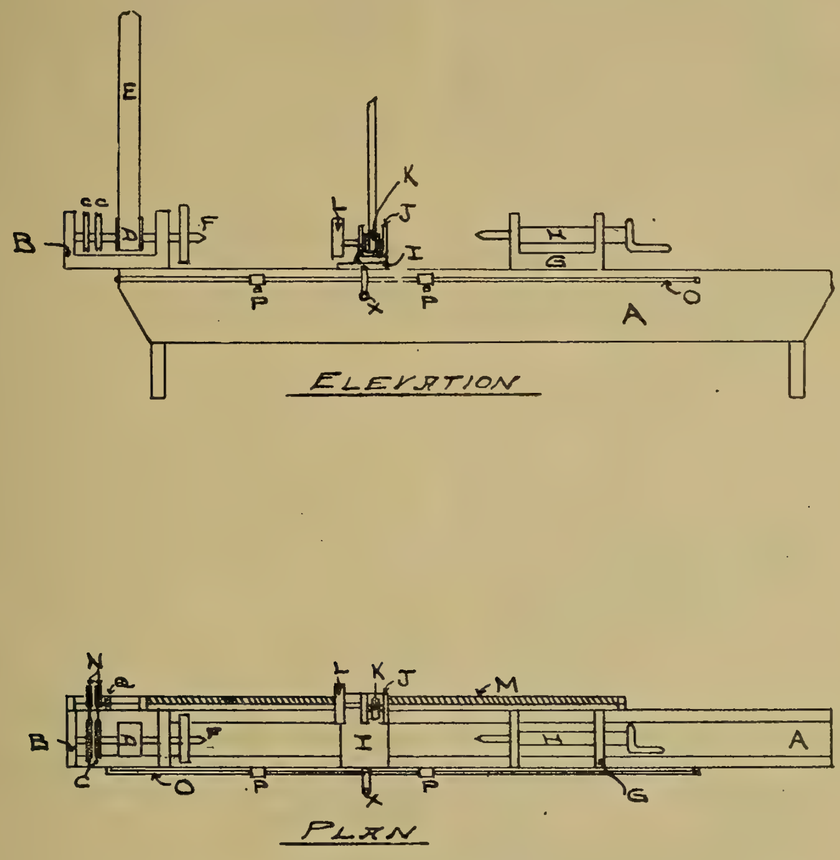


Fig. I. Buffing Machine.

At the right end is the casting G, supporting the spindle H. The plate I, in the centre, rests upon the bed A and supports the bearings for the pulley K and the emery wheel L. In front of the machine is the rod O with the collars P. At the back of the lathe is the rod M, a portion of which is threaded, and to which the plate I is attached. At the left end the rod has the pulleys N. The rod N. The pulley D is belted to a countershaft above. The pulley K is belted to a drum pulley on the same countershaft. This drum pulley is wide enough to accommodate the greatest distance that can be obtained between the spindles F and H. The pulley K is belted so that the emery wheel L will revolve in the opposite direction from the spindle F.

The operator fastens a small dog to one end of the roller to be buffed

and places that end on the spindle F so that the

DOG WILL COME IN CONTACT

with the face plate. The spindle H is then brought up to the other end of the roller. The belt on the counter shaft is then shifted to the tight pulley, causing the roller and the emery wheel to revolve, but in opposite directions. By turning the handle X, the plate I is brought forward until the emery wheel just comes in contact with the roller. We will now refer to the pulleys C and N. When the pulley D starts to revolve the pulleys C, being on the same shaft, naturally revolve also. As they are belted to N, the pulleys N will also revolve. Between the pulleys N there is a small clutch; this clutch is worked by means of Q, which is attached to the shaft M. It is, therefore, evident that when the clutch is engaged with one of the pulleys N, the shaft M will revolve in one direction and when the clutch is engaged with the other pulley N the shaft M will revolve in the opposite direction. As the plate I is attached to the shaft M, it will be carried to the left or right according to the direction in which M is revolving. As the emery wheel L is on the plate I, it will also move. We will now look at the shaft O. The two collars P are set so that each is just beyond either end of the roller in the lathe. There is a small dog projecting down from the plate I. When this dog comes in contact with one of the collars it causes the shaft O to move either to the right or left, according to which collar it comes in contact with. As the shaft O is attached to Q and as Q works the clutch between the pulleys N, it will be seen that the moving direction of the plate I is reversed every time the dog comes in contact with one of the collars P. In this way the emery wheel is caused to move back and forth across the surface of the roller. This is done until the leather has been buffed, so that the surface is even all the way across the roller.

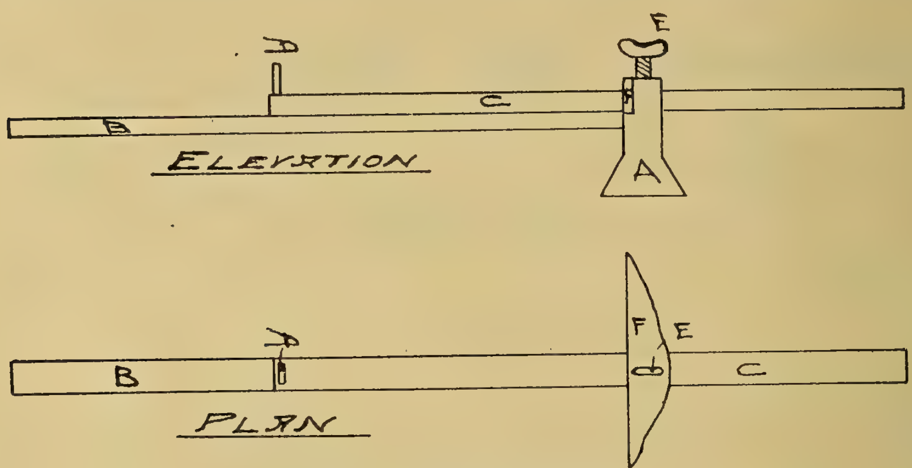


Fig. J. Stripping Gauge.

The roller is then taken from the lathe and is

READY FOR VARNISHING.

The writer will give only one formula for making a varnish, to give an idea of the constituents of a roller varnish. Dissolve one pound pulverized glue in two quarts of good vinegar; then add one-half ounce oil of cloves or oil of origanum and 8 to 10 ounces of coloring. The glue, vinegar and oil can be boiled for 15 minutes before adding color. The coloring may

be obtained by using any of the following in the powder: Vermilion, Venetian red, chrome green, chrome yellow, chrome red, lamp black, or ordinary blueing may be used, the object being to give body to the varnish. If, after applying, the varnish should commence to crack, it may be advisable to use a little less glue in the next mixing, or if not very bad,

Fig. K. Splitting Knife.

a little more oil of cloves or origanum may be used. If the varnish wears off too quickly, a little more glue may be added.

Having taken up the process of covering rollers, it might be mentioned that there should be a system used in covering the rollers, so that they may be covered as efficiently as possible. A good way to do is, late in the afternoon, to cut off the old leather cots and soak the rollers in hot water and scour well. At the same time the roller cloth should be cut into pieces for covering the rollers. The rollers should then be left all night in racks so that they will be dry in the morning. In the morning the rollers should be covered with the roller cloth and at the same time the sheepskins should be cut and made into cots for the rollers. After the rollers are all

COVERED WITH CLOTH,

the first ones covered should be taken and pushed into the cots and so on, until all the rollers are covered with them. The burning down or ending should then be done until finished, or it is time to start in cutting off the old roller cots.

The making of single belting is another use to which the belt and roll shop can be put. If the mills knew the saving that could be effected by making their own small belting it is probable that a great many more would do so than at present. When a batch of hides or slabs are received at the mill they should be examined carefully. Hides are bought by the pound. If a batch of hides are too thick they can not be cut up into as much belting as a batch that are thinner but weigh the same. If the hides are very uneven in thickness it means that there will be a lot of loss in the evening process. If the hides are too thin it means that the belting will stretch too easily. It should also be noticed whether the skins seem to have been stretched sufficiently when being cured. In other words, it should be attempted to get hides or slabs to which there will be as little loss as possible when being made into belting. The more belting obtained per pound of hide the more saving made by the mill.

FIRST PROCESS.

The first process in making the slabs into belting is the cutting up into the desired widths. This is done with the aid of the stripping gauge shown in Figure J. A is the stand to which B is fastened. The gauge C slides on B, and when at any desired position, is made stationary by means of the set screw E. The top surface of C is marked in inches and fractions of inches. D at the left end of C is the cutting knife. F is a straight edge for guiding the leather when being cut. If it is desired to make a 2-inch belting the gauge is set so that the 2-inch mark on C coincides with the

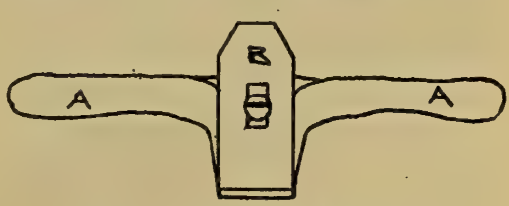


Fig. L. The Plane Shave.

straight edge of F. The slab or hide is cut from neck to tail.

The cutting-up is done best by using two men. One man stands at the back of the stripping gauge and holds the edge of the slab against the

straight edge while the other takes hold and pulls the slab toward him, the slab being cut by the knife as it is being pulled. The edge of a new slab should be trimmed so as to present a straight edge to F. This can be done by moving the knife up close to F and cutting a thin strip from the slab, or the gauge can be set a little wider than the desired width of belting required. The first strip cut off is then taken, the gauge set to the desired width and the strip is then trimmed off, the straight edge of the strip being held against F. After the hides have been cut up into the desired width of strips the strips are ready for evening.

This is done by

USING A SPLITTING KNIFE,

shown in Figure K. A is the stand supporting the roll B, above which is the knife C. The knife C can be raised or lowered by the screws D. The knife C is set above the roll B, so as to give the required thickness of leather, 3-16 of an inch being about right for 2-inch to 4-inch belting. The strips are then pulled between B and C, the knife shaving off the places thicker than that desired. The evening is all done on the flesh side of the hide.

The strips are then ready for sciving or scarfing, that is, beveling the ends so as to make laps, in order to cement the strips together. Figure M gives a view of about the simplest form of lap scivers. All others are made on this principle. The one illustrated is all right for narrow belts. It consists of the stand A. On the top is the knife B, which can be raised or lowered, according to the thickness of the leather. C is a curved piece of wood pivoted at D, whose radius grows greater as it nears the end farthest from the knife B. The operator marks off on the end of the strip the length of lap which he desires to make. For a narrow belt a lap twice the width of the belt should be used. He then inserts this end under the knife B, and with the handle E raises C until the knife comes in contact with the mark on the leather. He should then continue raising on the handle E, at the same time pulling back gently on the strip of leather. As the handle E is raised the surface of C comes closer to the knife, B thus forcing the knife farther into the leather. In this way the end of the strip is gradually tapered off. The strip should be scived at both ends, one on the flesh side of the leather and the other on the

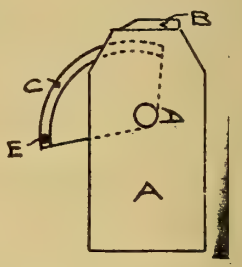


Fig. M. A Simple Form of Sciver.

hair side. The strips are then ready for the cementing of laps. To finish the lap to a fine edge a plane shave should be used. This is shown in Figure L. It consists of the casting with the handles A to which the cutter B is fastened. B can be moved up or down. The plane is applied to the lap and pulled toward the operator, shaving off the leather until the lap has been beveled to a fine edge.

A good cement

TO USE FOR THIS PURPOSE

is composed of 2 pounds of glue to one pound of Venice turpentine. The laps are cemented, placed together, and then pressed in a screw press. Figure N shows one form of screw press. A is the stand having the bottom plate, B is the pressing plate and is raised or lowered by means of the screw C. After remaining in the press for a short time the lap is removed and a new one substituted. When the pieces have all been cemented they should be measured, and a record of the number of feet of each width of belting kept. What waste has been made in the process of making the slabs into belting should be

looked over and all that is available should be made into loom strapping. In this way it will be found that with good, even hides there will be very little of what would be called dead or unusable waste. Some figures are given here to show what has been obtained from two different batches of hides. The writer wishes to call attention to the fact that in the first batch of 17 hides the weight is 103 pounds, and in the second of 16 hides

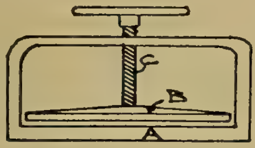


Fig. N. The Screw Press.

the weight is 154 pounds. From batch No. 1 approximately 89 square feet of belting was obtained and from batch No. 2 approximately 90 square feet was obtained. This shows that the difference in the weight of the hides was due to the thickness and not to the size of the hides.

BATCH NO. 1.

Number hides, 17. Lbs. weight, 103.

199 ft. 1″	belting = 5	hours' labor.
194 ft. 1¼″	belting, = 4½	hours' labor.
154 ft. 1½″	belting = 4	hours' labor.
199 ft. 2″	belting = 4½	hours' labor.
746 ft.	18	total hours' labor.
At, per hour.....$	.21	
Cost of labor.....$	3.78	

The price of the hides was 47 cents per pound, or a total of $48.41. Add to this the cost of labor and the total cost of the belting comes to $52.19.

BATCH NO. 2.

Number hides, 16. Lbs. weight, 154.

173 ft. 6 in. 1½″	belting = 4½	hours' labor.
132 ft. 1¾″	belting = 2½	hours' labor.
158 ft. 2″	belting = 4	hours' labor.
106 ft. 2¼″	belting = 3½	hours' labor.
98 ft. 2½″	belting = 3	hours' labor.
667 ft.	17½	total h'rs' labor.
At, per hour..........$	.21	
Cost of labor..........$	3.67	

The price of the hides was the SAME AS BATCH NO. 1, making a cost of $72.38. Adding to this the cost of labor, the total cost of the belting comes to $76.05. Taking into consideration the fact that there was some loom strapping made from the waste of the two batches means a saving there also. From an observation of No. 1 and No. 2 it will be seen that No. 2 was the costlier belting, due to the difference in weight between the two batches.

Taking the standard list price adopted in 1906 and referring to No. 1, we have:

199 ft. 1″	belting @ 24c............. =	$47.76
194 ft. 1¼″	belting @ 30c............. =	58.20
154 ft. 1½″	belting @ 36c............. =	55.44
199 ft. 2″	belting @ 48c............. =	95.52
Total	....	$256.92

The discount is about 70 per cent, 10 days, which gives a cost of $77.07. Subtracting $52.19, the cost of making the belting, from $77.07, the cost of buying the belting, and the result is $24.88 saved.

Referring to No. 2 we have:

173 ft. 6in. 1½″	belting @ 36c......... =	$62.46
132 ft. 1¾″	belting @ 42c......... =	55.44
158 ft. 2″	belting @ 48c......... =	75.84
106 ft. 2¼″	belting @ 54c......... =	57.24
98 ft. 2½″	belting @ 60c......... =	58.80
Total	....	$309.78

Taking a discount of 70 per cent gives a total of $92.93. Subtracting $76.05, the cost of making No. 2, from $92.93, gives a saving of $16.88.

It can thus be seen from the above figures that it would pay a mill to go to the expense of installing the necessary machinery and making its own narrow belting.

In addition to recovering rollers and making belting, the shop is required to keep all the main driving belts in good condition. There should be a certain

PERIODICAL INSPECTION

of the belts and at the same time dressing should be applied. Before the dressing is put on, however, the belt should be cleaned on both sides, to remove all dirt and gummy substances. The dressing should then be applied in moderate quantity. Too much dressing is as bad as none at all, as it will cause the belt to slip on the pulley. For a dressing that will soften a belt and make it pliable,

castor or neat's foot oil is as good as can be used. One oil is preferred about as much as the other.

For a dressing that will give a surface to the belt so that it will adhere better to the pulleys there are a great many different brands on the market. Some put rosin in the castor or neat's-foot oil for this purpose, but this is not considered a good thing to do, as it has been found that rosin has an injurious effect on the surface of the belt, causing it to become lumpy and crack. A dressing of this kind which will give adhesive qualities to the belt should be one which, if the belt should happen to slip a little, will not tend to roll up in lumps on the belt. The writer has known of some dressings that have done this and the noise of the lumps coming in contact with the pulleys could be heard.

Before a dressing of this kind is applied to a belt it should first be treated with castor or neat's-foot oil until it has become soft and pliable. The surface dressing should then be applied, which will tend to bind in the softening oils. The back of the belt should be treated with a softening oil so that it will be kept pliable and not tend to crack.

When belts are found to be running too slack they should have a piece taken out. This is termed taking up a belt. For small frame belts the belt is thrown off the pulley and a piece cut out. The small frame belts are mostly held together by means of belt hooks. After the piece is cut out the belt is clamped together and run on the pulley again.

To take up large belts,

BELT CLAMPS HAVE TO BE USED.

The writer will not go into details, as they are familiar to all mill men. Care should be taken in drawing up the belt not to get it too tight. If this is done it will cause the shafts to be pulled out of line and the bearings will heat up. A new belt can be drawn up tighter than an old one, as it will stretch after running a little time, while an old belt has had most of the stretch taken out of it if it has been carrying a load equal to its capacity. Belts nowadays are connected chiefly by making laps and cementing, forming what is called an endless belt, or by connecting with belt hooks. Conditions must determine just what to use. For a belt running over small pulleys a lap belt should be used, as the belt has to bend quite a little in going around the pulleys. When practical, however, the writer advocates the use of belt hooks. In taking up a lap belt, the process takes some time, as a new lap has to be made after the piece has been cut from the belt and what old part of the lap is left has to be scraped to remove all the old cement. After the cement has been applied, and the belt pieced again, it has to stand for some hours to dry before the belt can be used. On the other hand, with a hooked belt the clamps can be applied, a piece of the belt cut out, the belt hooked together again and the clamps removed. The belt is then ready for running. A hook belt can be taken up during the noon hour, whereas a lap belt has either to be taken up during the night or week end.

The writer has now given the chief uses of the belt and roller shop. There are a great many minor uses to which it is put. Looms require a great deal of strapping, which is usually made at spare moments. Small pulleys are lagged with leather, which is done by the belt shop. Old belts are patched up and put in as good condition as possible. In fact, when one stops to consider the different uses to which this department can be put, it becomes more apparent how important the belt and roller shop is to the mill.

Notes on the Steam Boiler

The numerous radical changes in power plant practice within the last few years has added many complications to former simple situations, and we find the power house of to-day containing a great variety of machinery and equipment. The introduction of electric lighting and transmission has probably had more to do with making these changes than any other one thing, and it is now indeed a primitive affair which has not at least a lighting generator or two, and possibly some few motors.

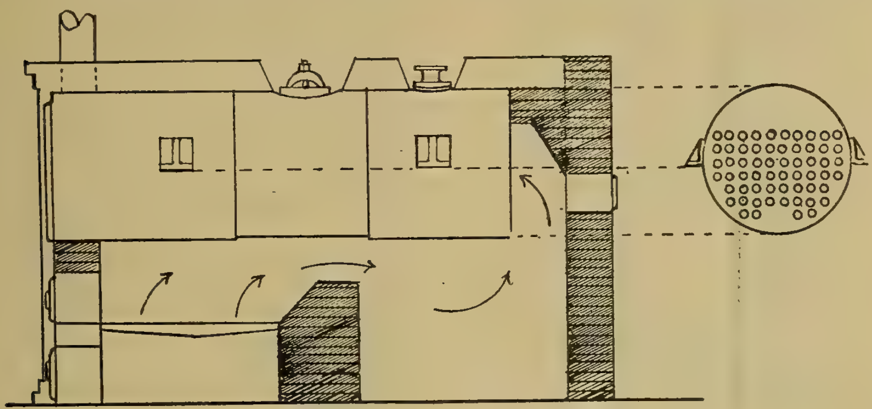


Fig. 1. Horizontal Tubular Boiler.

The boiler section of the plant which is the heart and foundation of the whole fabric is the most important branch of all, as it is here where the fuel is converted into heat and here where the opportunities for good or poor results are the most in evidence. The boilers in general use in textile power plants may be classed under three heads, horizontal fire tube externally fired, upright fire tube internally fired and the inclined water tube. There are cases where the horizontal internally fired, or "Scotch" boiler is used, and also the water tube type with vertical tubes, but they are so few that little need be said about them further than that they are both excellent boilers.

HORIZONTAL TUBULAR BOILER.

The horizontal tubular boiler (Figure 1), up to within a few years, was considered the standard American boiler, and was almost universally used in all industries. These boilers are reasonably low in first cost, simple in construction, and under favorable conditions are extremely economical. For many years, and until quite recently, a period which covers practically all the time that this boiler enjoyed its high reputation, there was a general opinion among boiler users and engineers that to burn fuel economically and get the most out of it the rate of combustion must be quite low, that is, the temperature of the fire should never be excessive and the amount of fuel consumed per square foot of grate should not exceed 10 or 12 pounds per hour.

On account of the difficulty in making material having the requisite strength for handling steam at high pressures, and the lack of knowledge in regard to the relative values of high and low pressure steam, the majority of boilers were constructed to carry pressure of 100 pounds, or

less. While these conditions continued, the

RETURN TUBULAR BOILER

held its own against all competition, but, however, as soon as higher pres-

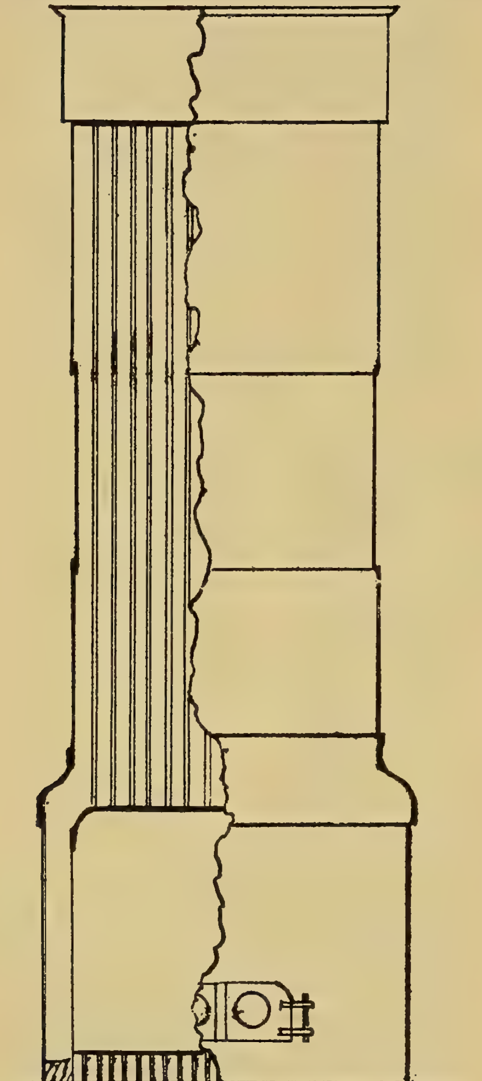


Fig. 2. One Type of Vertical Boiler.

sures and high rates of combustion began to be called for, many good authorities had serious doubts as to whether an externally fired boiler could be operated safely over a furnace fire at a temperature up to 2,000 degrees for any length of time, or that a boiler shell as thick would be required to withstand the higher pressures could be exposed to the fire at all without deteriorating rapidly. These doubts added to the realization of the advantages gained by using steam with some degree of superheat created a demand for a type of boiler which would be better able to stand the high pressures and higher duty, and meet other requirements as well. From this period on, the fire tube horizontal boiler has seldom been selected when erecting new equipment, except in a few cases where the old methods are still believed in and followed, or where separate superheaters are used to bring the steam temperature up to a proper point for operating engines and turbines.

The vertical fire tube boiler, although but very little known outside of the eastern states, has been well and favorably known for many years, particularly in connection with textile mills. This type is now built in various forms and sizes, one style (Figure 2) in which the body or waist is made smaller than the base around the firebox or "water leg" and connected to it by a pair of ogee flanges, has been in successful use for some twenty-five or thirty years. A later and simpler style is one in which the shell is of the same size throughout (Figure 3), and is termed

A "STRAIGHT UPRIGHT,"

the furnace being precisely the same as in the first style. It is comparatively new in the field, but has given good satisfaction generally. The inventor of the ogee flange boiler first mentioned claimed, in advocating his design, that the contraction and expansion of the outer shell in a boiler made straight had a tendency to impart a working motion to the heads at top and bottom, and thus brought a great strain upon the tubes, which, if not loosened to a dangerous point, could not be kept tightly in place and thus cause incurable leakage. This disadvantage he entirely overcame by

adopting the ogee flanges, which are of such shape that they take the strain instead of the heads and tubes.

The theory of elasticity was considered seriously for a long time until some boiler manufacturers who were prevented by law from building the ogee flange style, and being desirous of supplying their patrons with some sort of vertical boiler, if so requested, brought out the straight upright type similar in shape to the well-known portable upright, but made in large units and of exceedingly heavy material. The satisfactory service which these boilers have given has, in a way, exploded the theory of elasticity, and a change of opinion in regard to it may, perhaps, be illustrated by quoting the remark made by a prominent boilermaker, who said, "We used to think that the more flexible we could make a boiler the better, but now we strive to make it as rigid as if it were made of a solid piece."

One of the greatest objections ever experienced with upright boilers has been their inaccessibility, nearly all of the older styles being constructed so that there was no possible chance for a person to enter them for the purpose of examination or cleaning, and especially in localities where the water is full of scale-forming matter this feature has been a serious objection to their use.

MODIFICATIONS IN THE DESIGN have, at different times, appeared, but not until a boilermaking firm in New Jersey, after several attempts to design a vertical boiler adapted for economically burning the cheaper grades of coal, attained their object by increasing the diameter of the bottom or water leg section to provide for a larger grate area and joining this section to the waist or body by a conical or tapering section, was the problem of accessibility practically solved. This style of steam generator (Figure 4) met with favor from the start, and although at first controlled and built by only one company, it attracted sufficient attention to cause other boiler makers to adopt the design.

The three types of vertical fire tube boilers just described include practically all the patterns in use and are the only ones considered for new installation. The superiority of an "in-

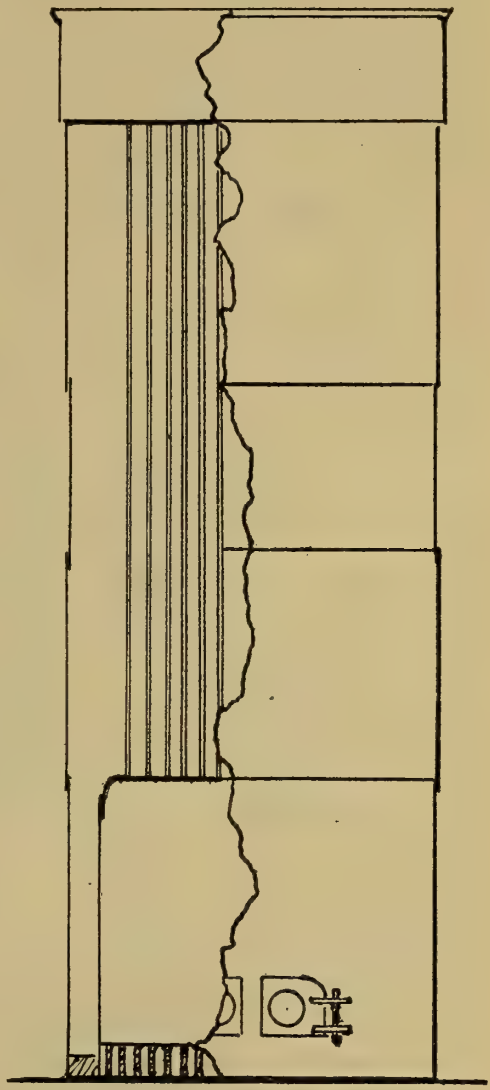


Fig. 3. The "Straight Upright" Boiler.

ternally fired" boiler (which all of the verticals are) over the type with the fire outside the boiler structure is quite marked, as the furnace is surrounded by metal sheets covered with

water ready to absorb every unit of heat, so that none can escape, as is the case when the fire is enclosed in a brick furnace. The matter of greater safety is also a feature, there being no surface exposed to the flames which cannot be stayed to withstand safely any reasonable pressure. In regard to the capacity of these boilers for furnishing superheat there is some difference and while all will produce steam superheated to a moderate degree, it is claimed that the two styles which have small bodies compared with their bases lead the straight type quite considerably, for the reason that in these the steam or superheating space is larger in

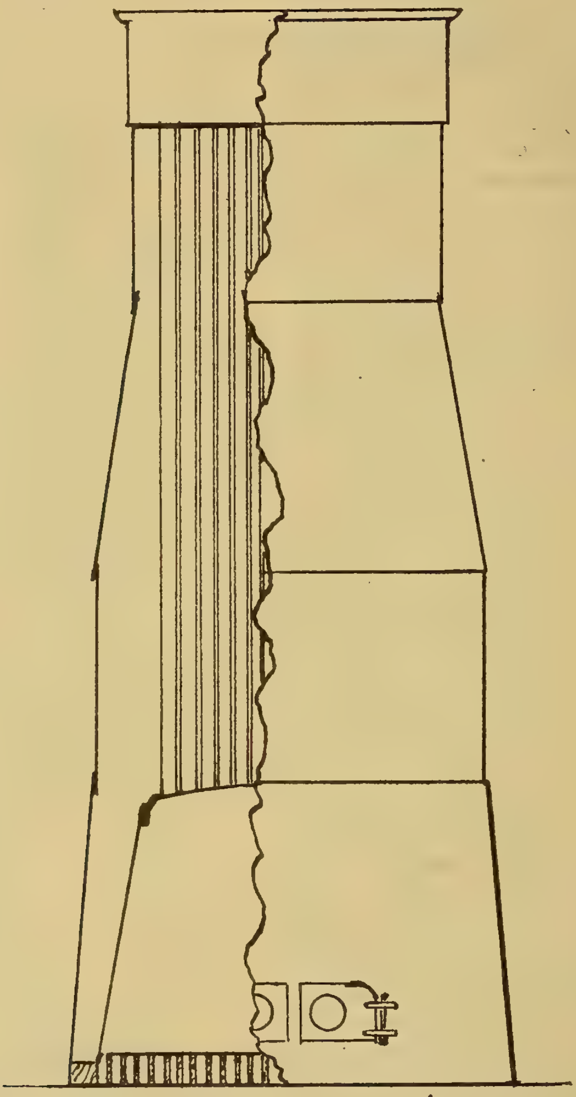


Fig. 4. Vertical Boiler with Diameter of Lower Portion Increased.

comparison to the water space than in the other.

The gain made by using

SUPERHEATED STEAM

for other purposes than power, such as heating and manufacturing processes, is not appreciated or realized among those who are supposed to know all about such matters, and, although the fact is accepted that superheat is of vital importance in connection with power practice, there is little conception of the advantages gained by applying the same principle to the service steam.

An instructive proof of this was furnished in a plant which was considering additional boilers to generate steam for a new dyehouse. The original boiler equipment consisted of several of the standard return tubular type, and no reason was conceived why the new units should not be of the same class, as they had always given satisfaction. One of the competing boiler makers who were bidding on the contract, and one who had had a large experience in building both horizontal and upright types proposed that they put in a battery of vertical units, claiming that, while they could not be expected to show any more economy in operation, the superior quality of the steam would work a great saving in condensation bound to occur in a long sinuous piping system, when moist steam at a moderated pressure is employed. His argument was so attractive that his firm was given the contract, and a battery of uprights of the most approved type was installed. As the equipment at this plant was so arranged that the dyehouse system could be supplied with steam power, from either the new or old boiler plant, no time was lost in improving the opportunity by running a week from one set and the next week from the other for a term of two months or more.

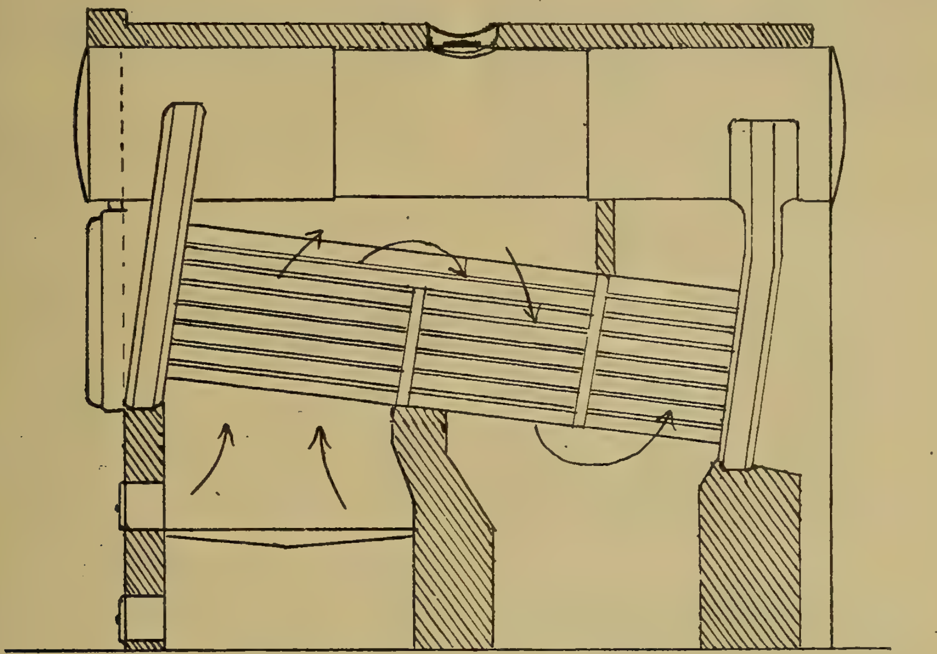


Fig. 5. The Water Tube Boiler.

THE AMOUNT OF FUEL

burned in each battery was compared

and showed a saving of 15 per cent for the vertical boilers over the older type. Notwithstanding this in subsequent evaporative tests the horizontals showed a greater efficiency by some ten per cent, which indicates conclusively that the saving was realized by sending dry superheated steam into the system which prevented excessive condensation and arrived at the point where required in a condition to do the most efficient work.

The water tube type of boiler (Figure 5) was invented some forty years ago, and since that time, until recently, has been so changed and modified in form and design of construction that really no standard could be determined upon. At the present time, however, the situation has simplified sufficiently to enable them to be classed under three heads, the inclined straight tube, the crooked tube (also inclined) and the vertical straight tube, and probably ninety per cent of the water tube boilers in use belong to one of the above varieties. The advantages claimed from the first were chiefly on the line of safety and quick steaming qualities. These features have been probably more instrumental in bringing them into general use than all others, although they have

SEVERAL ADDITIONAL POINTS

in their favor, such as lightness of parts (which makes the matter of transportation and erection a simple affair compared with the handling of those of the fire tube type), accessibility for cleaning, durability and many others. The arrangement of tubes in this boiler is such that the entire amount of water is confined in small sections, and consequently there are no large surfaces to fortify against the internal pressures and in place of metal of great thickness with its necessary weight and uncertainty in regard to its soundness (as is required in the other types), lighter and more ductile material is allowable, even for the very highest pressures carried by the modern steam plant. This separation of the water into small bodies which are nearly surrounded by the hot flames and gases from the furnace is plainly conducive to the quick generation of steam as the water is attacked by the heat from all sides. It is also evident that the powers for holding quantities of heat are somewhat less than in the horizontal fire tube style where there is a larger body of water kept in reserve under pressure. In other words the water tube may be

TERMED MORE "FLASHY"

in its action than the return tubular unless there be provision made for water storage, as is the case with some makes.

Theoretically, the two types of boilers, fire and water tube, should show the same, or nearly the same, economy or evaporative efficiency. The practical results, however, seldom confirm this and, as a general rule, in actual practice, the fire tube will stand ahead in water evaporation per pound of coal. This is admitted by many of the water tube advocates who are willing to allow a superiority of from 5 to 10 per cent for the fire tube when the two are tested together. They claim, notwithstanding, that, when the question of repairs, safety and adaptability to improved furnace conditions and the other advantages are taken into consideration, the water tube is by far the more satisfactory piece of equipment.

The cause for the better showing in general evaporation of the fire tube may, perhaps, be explained by considering the action of the heated gases after leaving the furnace grate. As every one knows, the greater part of the heat in the fire tube boiler is absorbed by the heating surfaces of the tubes which, if properly arranged, will reduce the temperature of the gases from that of the fire at the grate to as low as 400 degrees at the chimney end of the boiler. This result is brought about by the great capacity of the

WATER-COVERED TUBES

for carrying off the heat from the gases which impinge upon the concave surfaces with much the same intensity as the flames strike the

arch of a brick oven. That this is not the case with the water tube is evident for the reason that the tube surfaces presented to the gases are convex instead of concave, and do not absorb the heat as efficiently. This fact has been substantiated by tests made with water and fire tubes of the same given area of heat absorbing surface and further proven by the invariably high temperatures of the escaping flue gases from a water tube when compared with the other variety.

Between the different types of water tube boilers there is little to choose, their performance under duty being about the same. The vertical type has the same relative advantage over the horizontal (or inclined) in respect to the delivery of dry steam that the vertical fire tube has over the horizontal fire tube. Another advantage possessed by the vertical water tube and one in which it excels all others is its capacity for handling muddy or scale-forming water, the scale and impurities falling directly into the lower drum (which is comparatively cool), where they can remain in suspension until blown out or mechanically removed.

In the first part of this article attention was called to the superiority of the internally fired boiler over one in which there is chance for much heat to escape through furnace walls of brick, and also to the now acknowledged advantages of maintaining a

HIGH RATE OF COMBUSTION

and high furnace temperatures. To obtain this ideal high duty in an internally fired boiler furnace has been found very difficult on account of the lack of room for the grate surface required, and also space for the proper mixture of the gases to create perfect combustion, and any attempt made to force the fires in such boilers generally results in a great amount of smoke and lower efficiency. This trouble is more evident when coal containing much volatile matter, like the Western products, is used, the combustion being so restricted that most of the volatile matter escapes in the form of smoke and soot. To meet this condition the form of furnace known as the reverberatory or Dutch oven (Figure 6) has been introduced and is fast gaining favor.

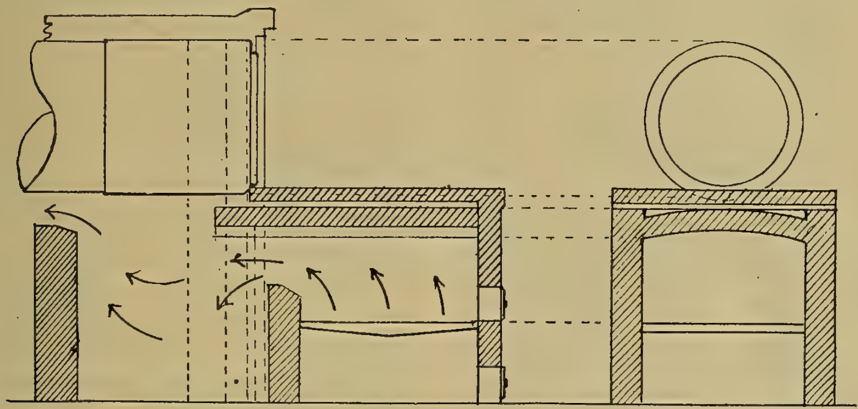


Fig. 6. The "Dutch Oven" Furnace.

This furnace is constructed along the lines of the ordinary furnace used under the horizontal tubular boiler, the only addition being an arched roof made of fire brick, generally about four feet above the grates. In operation this refractory roof is heated to a very high temperature, and as fresh coal is introduced, the oily or volatile matter is immediately formed into gas and instantly ig-

nited by the heat from the incandescent brick and joining with the flame from the solid part of the fuel produces a clear fire of great intensity. In this way the volatile matter becomes a valuable addition to the heating capacity of the fuel, whereas in furnaces of the ordinary pattern the process of ignition is so low that most of the valuable ingredients pass off unburned in the form of smoke and are of no value for generating steam.

It is necessary with this furnace that some considerable space be provided between the grate and the heating surfaces in order to give the gases a chance to mix and create what is called "perfect combustion." For this reason, then, the furnace is generally placed outside the boiler setting, and being, so to speak, an independent element of itself, it can be placed before any type, and if properly arranged can be made to

GIVE EXCELLENT RESULTS.

The principle of the reverberatory arch is carried out in the construction of many of the "mechanical stokers," and, in fact, is the foundation for their wonderful success, for by no other means could the smokeless and uniform combustion of the fuel be obtained and at such a rapid rate. In this case it seems, therefore, that notwithstanding the evident opportunity for the escape of heat through the side walls and roof of a Dutch oven, or reverberatory furnace, which would apparently be a serious handicap when compared with the internally fired boiler furnace, that they, by their much greater ability for extracting the heating value of the ordinary kinds of fuel, outclass every other form in ultimate efficiency and capacity for overload.

THE EXTERNAL CLEANING

of a boiler is a very simple but disagreeable process, and particularly in the smaller plants, where the man in charge considers the boilers are a necessary evil anyhow, do we find that the work of cleaning is sadly neglected. It is very hard to believe that anyone will neglect a duty which by so doing will add to his work as a whole, but it seems to be the situation in this case, for in a one-man boiler plant, where any extra diligence on the fireman's part in cleaning the soot from the heating surfaces will act directly toward the lessening of his labor of firing, we often find the worst conditions of all.

A fire tube boiler, either horizontal or upright, should be provided with some means for blowing the soot from the tubes, either with air or steam at a very high pressure. The blowing operation should be performed as often as is required to keep the tubes free from soot, and no definite rule can be laid down on account of different conditions prevailing in each particular place, such as draft, quality of coal, light or heavy duty, etc. To ascertain as nearly as possible the amount of blowing necessary to keep up to the point of economical operation, an experiment was tried by the writer upon a battery of three upright

FIRE TUBE BOILERS.

It had been the custom to blow the tubes every Saturday, and, to commence with, the temperature of the gas in the uptake was taken at 9 o'clock Monday forenoon when the fires were at the regular working stage. The temperature was then taken at the same point on Saturday at the same time with the fires, in as near the same condition as could be secured and an increase shown of approximately 150 degrees. The interval between Saturday of one week and Saturday of the next week was then divided and a blowing given on Wednesday. This brought the temperature on Saturday morning down to only 70 degrees in excess of the minimum. The interval between blowings was again shortened by blowing on Tuesday and Thursday, as well as Saturday, making three cleanings a week.

The result in this case showed so little gain that after repeating the different schedules for several weeks it was decided that the gain realized from the third application of the blower did not warrant the extra ex-

pense incurred. A continuous test with the same object in view was made in a power station in New York some time ago. On this occasion a recording thermometer was used upon a boiler working under practically constant load night and day, and commencing with clean flues,

THE TEST

was run for several days until the usual time for cleaning came around, when a chart was obtained which indicated an almost continual increase of temperature of the escaping gases from the start. Both of the above tests serve to show that the matter of cleaning boiler flues is one which requires a good deal of attention on someone's part, in order that the most efficient service may be maintained. In addition to blowing the tubes they should be scraped at regular intervals, which would seem to some quite unnecessary. There are, however, influences present at all times which tend to harden the soot and fasten it upon the heating surfaces in the form of a crust, which no blowing, however powerful, is capable of removing, but which can be easily dislodged by the mechanical action of a good scraper vigorously applied.

The problem of keeping the tube surfaces of a water tube boiler free from soot is very easily solved by blowing, but the work must be diligently attended to or the heating efficiency will drop off at a much faster rate than with the fire tube, on account of there being a greater number of recesses and nooks where the heat-resisting material can be deposited. To keep the inside or water side of boilers clean is a greater, and oftentimes more difficult, task than the removal of soot and ash, and the damaging effects resulting from the presence of any substance like mud or scale which prevents the water from reaching the metal surfaces are fully as pronounced as those from uncleanliness on the outside.

No definite or detailed methods can be prescribed for reducing and removing boiler scale, as conditions are never the same in two different localities, which may require strenuous work in one case to prevent the formation of scale in large quantities, while in another the quality of the water may be such that little attention is required. It is, therefore, only proper to say that in every instance the boilers should be kept clean at any cost and methods should be adopted which are necessary to attain the results, whatever they may be.

In the early days it was not considered advisable to throw a boiler away so long as any part of it remained intact, and, as a consequence, the business of renewing tubes, sheets and braces was quite a feature of the boiler maker's work. The workmanship and material of the time were much inferior to those of the present, which added also to the necessity for more or less of these

REPAIRS.

Of late, however, since the high pressure and high duties have come into vogue, the insurance companies, and others who are responsible for the satisfactory and safe conditions around the boiler plant, are refusing to allow any of the old-time patchwork to be done, and when leaks and fractures do occur (which is very seldom now, on account of the better quality of material and the substitution of machine work for hand operation) the boiler is either returned to the shop to be rebuilt or thrown out altogether. This improvement in practice has eliminated about 90 per cent of the work generally considered as "boiler repairs," so that aside from an occasional instance (where, by the use of the portable welding systems now coming into use, some jobs can be done in a more efficient manner than has been heretofore known) the repair work on the boilers proper consists mainly in replacing tubes. In the upright type of fire tube boiler (Figures 2, 3 and 4) there is always more or less trouble experienced from tubes leaking at the crown sheet directly over the fire. The cause for this is quite evident when taking into account the intense heat to which the tube ends are subjected, and the effect that this heat would naturally have upon a thin piece of unprotected

ductile metal like the section of a charcoal iron tube.

It follows, then, that if any sediment is allowed to collect upon the crown sheet, which in any way prevents the water from covering these tubes where they are expanded into the sheet, and thus protect them from the fire, leakage and possibly other serious results are inevitable. As the crown sheet in this design of boiler is the natural repository for all scale which forms upon the tubes above and then when loosened falls down upon it, and also more or less mud and sediment, it is plain that unless the boilers are kept exceptionally clean the tube ends are liable to become partially covered in a short time, particularly if the water used contains much matter tending to form scale or mud.

DEPOSIT OF SEDIMENT.

If the deposit of sediment is allowed to increase until it cannot be removed either by the water hose or by some mechanical cleaning rod, the only method by which the trouble can be stopped is by taking out one or more of the tubes, thus making sufficient room to get at the objectionable mass. The task of removing and replacing tubes in a boiler is one which is usually considered beyond the scope and ability of the mill mechanics, and a force from the boiler shop is usually summoned for any emergency of this kind. Unless the requirements are greatly out of the ordinary, this work can be done by any handy man at a much less expense and usually in as satisfactory a manner as by the average run of boiler makers.

In any event, the subject is an important one, and one worthy of consideration, as the greater part of the repair work necessary in connection with the internally fired fire tube boiler and a considerable portion of that required in all other types lie along this line. Repairs to the masonry or brick work of all boilers which are set in brick or have furnaces of this material are one of the chief items of expense in the

MAINTENANCE ACCOUNT

of the power plant.

The comparative amount chargeable to each particular type of boiler or furnace depends mostly upon the individual design and the duty required, and it is reasonable to expect that there would be a great difference in this respect between the boiler doing moderate duty and one in which the fires are pushed to the utmost. The item of repairs on furnaces and masonry is given much weight by the people who usually have the power in deciding upon the type of boiler to install for a given purpose, and the matter of running expense receives much more notice in the circles where the bills are paid than the savings and benefits that are derived by operating a high duty furnace with its necessarily many repair bills. On this account many times a really desirable boiler has been rejected when considering additional equipment and one which is inferior in every respect is installed simply because the former type is known to require more frequent and expensive repairs to its furnace. This applies particularly to the reverberatory furnace, which, like all other highly efficient apparatuses, deteriorates most rapidly and even with the most durable material at present known is bound to show a large repair expense.

MECHANICAL SUPERINTENDENT.

Mill Construction
AND POWER

Cooling Ponds

Figure 40 shows a portion of the cooling pond in use at J. & P. Coats, Ltd., Pawtucket, R. I. The illustration shows the spray nozzles in operation. Some conditions are more favorable than others for employing cooling ponds, nozzles of a cooling pond. Cooling ponds which have no spray nozzles require little or no extra power for circulating the warm water. This type of pond is often of value, but its cooling capacity cannot be compared with the kind illustrated in Figure 40.

Fig. 40. A Typical Cooling Pond.

Fig. 41. View of N ozzles in Operation.

some engineers preferring them to cooling towers and some favoring the tower. A certain amount of power is required to pump the hot water to the top of a cooling tower, but this is about equal to that required to maintain the desired pressure at the spray

Spray Nozzles

Many obstacles have been encountered in designing practical spray nozzles. It is necessary to obtain a nozzle which will not easily become clogged. At the same time, the spray should be uniform and fine. The orifice of

a nozzle must be well made. If it becomes worn, the nature of the spray will be altered and generally cause a decreased evaporation. It is desirable to have nozzles constructed so that their capacity will be large with the water under low pressure. It is readily seen that it is difficult to combine all of the above requirements.

Nozzles are upon the market, however, which give good results. Those used at the mill of J. & P. Coats, Ltd., have a clear opening at the orifice which is eleven-sixteenths of an inch in diameter. They are connected to 2-inch pipes. Figure 41 is a nearer view of several nozzles and illustrates more clearly the shape of each spray.

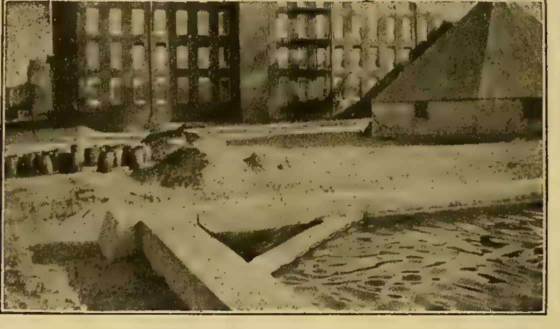


Fig. 42. The Spillway.

Capacity

The cooling apparatus at the Coats Mill is designed to furnish condensing water for 7,000-horse power. Five main spray lines supply hot water to 360 2-inch spray nozzles. The pond itself is 170 feet long, 160 feet wide and 6 feet deep. When filled to the top of the overflow, it holds about 900,000 gallons.

One end of the pond is separated from the remainder by a concrete partition. At the bottom of this wall there are openings which allow the cold water at the bottom of the pond to flow into the enclosure, from which the water flows to the condensers.

Outlet

At the opposite end of the pond, one corner is fitted with an overflow or spillway. This corner is shown by Figure 42. There is a large drain pipe with a shut-off valve connected to the bottom of the pond near the spillway. By opening this valve, the entire pond may be quickly drained. The walls and bottom of the cooling basin are all of concrete.

Cooling ponds require considerable room. Some textile mills have plenty of land, and do not consider this of great importance. Others would find it almost impossible to use so much ground space. Cooling ponds are valuable to some plants on account of the available water supply in case of fire. Fire pumps can be installed, with their suction pipes drawing from the cooling basin.

Cooling Capacity

Before the nozzles were all installed at the cooling pond for the Coats Mill, several tests were made to ascertain the cooling capacity of the system. With an average load of 2,700-horse power upon the condensing power units, the following results were obtained:

TEST UPON COOLING POND.

Date, 1910.	Atmospheric temperature.	Temperature of water to cooling basin.	Temperature of water to condenser.	Relative humidity.
Apr. 11	50	77.5	62.5	..
May 4	49	89	70	..
June 15	83	105	86	63
July 9	91	106	88.5	48
Aug. 25	83	104	89	71
Sept. 19	54	89	70	66
Oct. 8	54	88	70	..

Proper Size of a Cotton Mill

[Article Number One]

What is the most convenient size for a cotton mill, and please state why you decided upon this size, both respecting the proper location for machinery, the work of overseering and all other features which go to make up the conclusion.

It has been stated that the increased size of cotton mills approaches the non-economical point when they reach 85,000 spindles.

One of the most economical and convenient sizes for a cotton mill to manufacture the most common cotton cloths would be one of about 82,800 filling ring spindles and 80,000 warp. What we mean by the most common cloths are such as grey goods, sheetings, shade cloths, etc., the counts being 28s warp and 45s filling. To put in one building the amount of machinery that the above organization calls for demands a building of large dimensions.

To eliminate as far as possible the use of artificial light it is seldom advisable to erect mills much wider than 90 feet. At one time picker rooms were frequently built in separate buildings, placed near the end of the main mill. These buildings darkened the main mill building, and were objectionable. It is, therefore, better to place the

PICKING MACHINERY

at the end of the main mill, separated from it, however, by a substantial fire wall.

The square mill built large enough to accommodate the required machinery would have large areas so dark that artificial light would have to be used during the entire day. This makes it advisable to build mills long and comparatively narrow.

Formerly, a long mill was objectionable on account of the excessive lengths of line shaftings, and long line shafts use large amounts of power. Long lengths of small shafting become twisted and out of line, while larger shafting is much heavier, and for this reason, increases the friction losses.

The objection to long mills on account of shafting losses is no longer important. The changes introduced by modern electrical apparatus make it possible to limit the length of line shafting as much as desired. Some of the machines can be individually operated by small motors, and the remainder should be divided into many groups. Machinery can be placed in the locations best suited to reduce the labor cost, irrespective of the location of the driving pulleys. Mill buildings should be constructed with dimensions suitable for proper spacing of the machinery, and should be designed to admit as much evenly distributed daylight as possible.

It has been stated that the increase in size of a cotton mill approaches the non-economical point when designed for 85,000 spindles.

Now, is the above statement true? If it is not true, why was such a statement made?

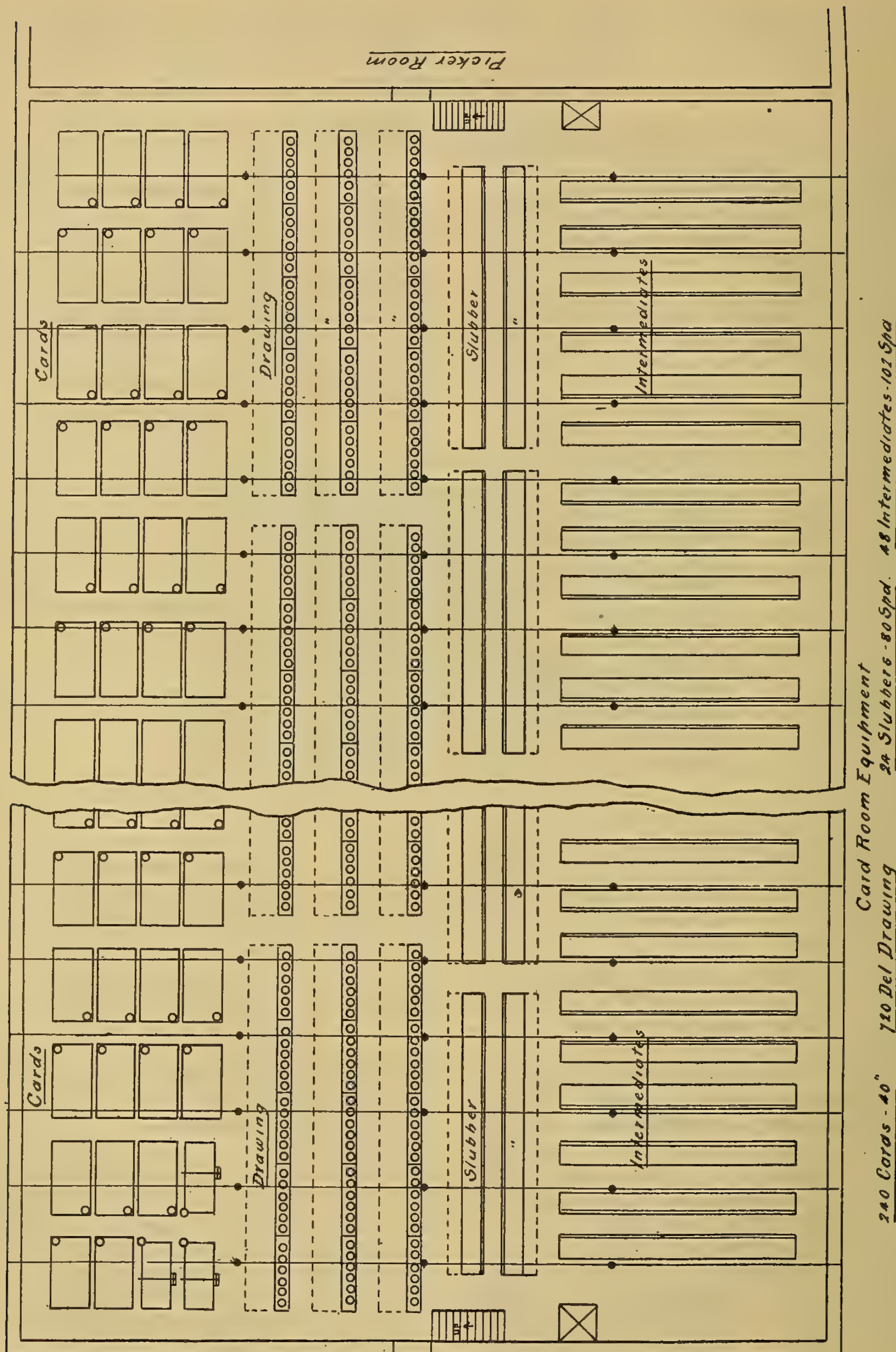
It is not true, and the only reason that can be advanced by mill men who conceive such an idea is by claiming that the departments are made too large for the overseers, and the

MACHINERY SUFFERS

through neglect. It is pointed out that they are unable to give their personal supervision which they otherwise could if the department was smaller, and so they make 85,000 spindles the maximum gauge point.

The writer is willing to admit that the above is true for some men, but we would like to ask those very men why it is that the same deplorable conditions often exist in mills where the departments are small. It is a fact that many mills having a large corps of overseers turn out poor work and waste money.

Poor supervision is caused by employing poor overseers rather than by


Picker Room
Cards
Drawing
Slubber
Intermediates
Card Room Equipment
240 Cards - 40"
120 Del Drawing
24 Slubbers - 80 Spd.
48 Intermediates - 102 Spd

the inability of good men to keep in personal touch with the important details. A certain class of mill men are too reticent about changing their methods in operating their plant. The man who has for years been connected with a certain mill knows its needs as no other person can, but with competition as it exists to-day, he must keep in touch with the others and must be willing to make changes which at first often seem expensive and unnecessary.

THE GENERAL DESIGN

and details for a new mill should be worked out by a competent mill engineer. He should be familiar not only with mill construction, but with textile machinery. The new mill agent should be held largely responsible for the size of the mill, arrangement of departments and many details of construction. He should take these matters up with the mill engineers and no controversies which arise should be settled hastily.

The mill agent should have a general knowledge of all local operating conditions which vary with the class of goods manufactured. He should obtain the advice and opinions of his future overseers, so far as it is possible and practical.

There is not a subject pertaining to a cotton mill that requires more special treatment than the arrangement of the drafts in the various machines. This should be dealt with prior to even dealing with the constructive details. Does not the amount of draft on each machine determine the size of the mill? To make the above point clear, let us assume that two men are building a mill, and one man believes in short drafts throughout the mill, while the other man believes in long; the latter would equip his mill with six slubbers running .50 hank slubber roving, while the other man, who understands his business and believes in short drafts, would run .75 hank slubber roving. He would be obliged to equip his mill with nine slubbers for the same number of yarn and production.

The above is simply given to show that the amount of drafting does determine the size of the mill. It is

OF UTMOST IMPORTANCE

that in building a mill due regard is paid to the proper drafting of the machines. The range of counts and the desired production should be considered and the proper equipment installed for obtaining maximum efficiency.

Let us assume that we build a large mill of 85,000 spindles, and in order to save in the initial cost, the proper number of machines preceding the spindles is reduced and their draft made long. With such a hang-up the mill would run fairly well just as long as the same or a better stock was used. If the price of cotton is greatly increased, does the buyer before purchasing a cheaper grade carefully consider the effect of this change upon the operating end of his mill? Some do, but many do not. This is not because they do not know better, but their mind is so centred on saving a few dollars on the price of cotton that they seem to lose sight of the fact that the machines are limited. What happens?

When the poor stock hits the card room the carder, no matter how careless he may be, will have his attention called to the soft roving by the speeder tenders. This is plain to all practical men, because the poor stock will not stand

THE LONG DRAFTS,

and the staple of this cotton, which is altogether too weak in the first place, will not have that tendency to hold together, but instead it becomes more fluffy, with a tendency to fly, which, of course, makes the strand lighter and the bobbins softer. A certain amount of twist must be inserted, which, of course, lessens the production.

It is only natural for such men to say that they are sorry that such a large mill was built. They do not even conceive the idea that they are really to blame for existing conditions. Is it not also true that when you visit most mills the superintendent or some

of the overseers will tell you that they have a poor hang-up, but that they cannot help it on account of a shortage of machinery?

Again, is it not a fact that in some of our cotton mills the production in the card room falls off fifteen to twenty per cent in the summer months, while in others you will find very little difference? What is the cause? The only answer that can be made is that the trouble is in the equipment, the management or both. Is it not true that in many concerns composed of from two to seven mills you will find that one overseer with the same equipment will turn off a better and larger production than others? How is it that this can be done? The only answer is that one man understands cotton and knows when to take out and when to insert twist, and for this very reason he is able to run his room no matter how large it is, while, on the other hand, no matter how small the room is, it is too large for a man who does not understand the peculiarities of the cotton staple. Is it not a fact that such conditions are now existing in

SOME OF OUR MILLS?

Often you find a good carder in a small mill who has his heart and soul in his room and will make his rounds now and then and examine the strippings, waste, etc., and when he lands a similar position in a large mill and carries on the same practice, he is quickly told by the overseers to let the second hand do that; even the superintendent will stop him.

Now we do not wish to be misunderstood and have the reader take it for granted that an overseer should do a second hand's work, for we are quite opposed to it. We are also opposed to a man not giving the best of his knowledge to the mill for which he works, simply because he has, perhaps, a couple of assistants to help him

Let us assume, on the other hand, that when a sample of cotton is received at the office, the agent or overseer is sent for, and the question put to him whether, if such stock is bought, there will be a loss or gain? Surely no reader can argue that the above would be a bad plan.

Now let us assume that an

85,000-SPINDLE MILL

is built and that the amount of machinery installed is slightly more than that which would supply the number of spindles. What is the result? In the winter time, when the work is running better than in the summer, the carder can make a lighter hank roving without injuring the stock, and this benefits the spinner; on the other hand, in the summer time, when the work does not run so well and a slight decrease in the carding production takes place, the hank roving can be made slightly heavier and the draft in the spinning increases. The work can thus be balanced. It must be understood that in order to accomplish the above due regard must be paid to the proper drafting of the machines; that is, a mill should be equipped with enough machinery to prevent making the draft excessive no matter what kind of stock is used.

A scheme of drafts which would be suitable for long stock would be utterly unsuitable for short. The mistake of overdrafting a mill is too often made. Many spinners in both large and small mills are running their rooms with a draft of fourteen on their frames when running double and as high as eight when running single. Again, carders in both large and small mills have drafts on their cards from 80 to 110, no matter what kind of stock is used. Drafts are also frequently excessive on the drawing frames, slubbers, intermediates and fine speeders.

Let us next consider

THE DISADVANTAGES

of a small mill: (1) The small mill cannot pay as much for an overseer as the large mill can, and for this reason, the chances are that the small mill is more liable to have an inferior man. Again, we do not wish to be misunderstood, as there are many good men working as overseers in small mills.

It must be admitted, however, that the larger mills have the advantage

of picking the best men, simply because they are able to pay a higher wage. (2) In a small mill it is very difficult to run a variety of yarns, simply because you have perhaps only one or two feeders, and as these have to be stopped and cleaned every time the stock is changed, this amount of stopping in such a small mill is often the cause of turning what would otherwise be a gain into a loss.

In a small mill, it often happens that an important man is obliged to be away from the mill, and the overseer must then put much of his time in handling this work.

In a large mill, it is different. Assuming that it requires three men to supply the feeders with cotton, and that one man is unable to work, the overseer can then double the two men up for a day or two, and the extra pay can be divided between them. The above is a practice that is adopted to advantage in many large plants.

In all departments of a large mill, extra help is always available by temporarily doubling the work and paying for the same in proportion.

Let us now

COMPARE THE COST

for overseers, superintendents and treasurers of a small mill with that of the same officials in a large mill. As a rule, the overseer of a mill consisting of 10,000 spindles gets about $2.50 per day, the superintendent $5 per day and the treasurer $5,000 per year. But in a mill with the organization quoted above, the overseer would get about $30 per week, the superintendent $5,000 per year, and the treasurer $10,000 per year. Five overseers at $15 per week equals $75. The superintendent at $5 per day equals $30 per week, and the treasurer at $5,000 per year equals $96.15 So we have $75 plus $30 plus $96.15 equals $201.15 per week. Assuming that a pound per spindle is produced, we have $201.15 divided by 10,000 equals $.0201, cost per pound for the managers of a small mill.

Five overseers at $30 per week equals $150. The superintendent at $5,000 per year equals $96.15 per week, and the treasurer at $10,000 per year equals $192.30 per week. So we have $150 plus $96.15 plus $192.30 equals $438.45 per week. Assuming that a pound per spindle is produced as in the first case, we have $438.45 divided by 162,800 equals .00269 cost per pound for administration of a large mill.

We think we have placed each wage

ON A FAIR BASIS,

and from the above figures, there is a difference of over 1¾ cents per pound in favor of the large mill.

We will now calculate the number of machines and their size to supply 162,800 spindles. A warp frame running 28s yarn should turn off 1.3 pounds per spindle, and a filling frame running 45s yarn should turn off .70 pound per spindle. This averages one pound per spindle or 162,800 pounds.

As stated, it is not good policy to drive the machines to their limit. As 10,500 pounds is a fair week's work for a picker, it will be necessary to have 12 breakers, 16 intermediates and 16 finisher pickers. This gives a production of about 168,000 pounds, which is necessary so that the picker room can be stopped part of Saturday to clean and scour the machines.

A card running a 50 to 55 grain sliver should turn off 700 pounds per week. 168,000 divided by 700 equals 240 cards. Running one card to each delivery, with three processes of drawings, six deliveries to each head would give 240 divided by 6 equals 40x3 equals 120 heads or 720 total deliveries. A slubber spindle running 62.5 average roving should turn off 90 pounds per spindle. 168,000 divided by 90 equals 1,866 spindles. Eighty spindles to a slubber is about the right number, so that the tender can run a pair and do justice to the work. Above this number has proven poor economy. 1,866 divided by 80 equals nearly 24 slubbers.

We are taking the full production without a loss in the above calculations, although there is a loss of 4½ per cent on the cards alone.

The reason for this is, as stated, that with such a hang-up, the carder can manipulate his drafts at all times so that all

PROCESSES WILL BALANCE

each other without injuring the staple. When there is plenty of slubber roving, the drawing sliver should be made lighter, and when there is a shortage of slubber roving the drawing sliver should be heavier and the draft increased on the intermediates.

Similar changes can be made in the slubber drafts to regulate the production between the drawing and slubbers. The same can be done between the fine

SPEEDERS AND INTERMEDIATES.

No machine should be pushed to its limit at the start.

An intermediate spindle running 1.80 hank roving should turn off 35 pounds per week. 168,000 divided by 35 equals 4,800 spindles. 102 spindles to each intermediate is about the proper number. 4,800 divided by 102 equals 48 intermediates.

A fine speeder spindle running 4.50 hank roving should turn off about ten pounds per spindle per week. We now must separate the warp spindles from the total spindles; 80,000x1.3 equals 104,000 pounds, 104,000 divided by 10 equals 10,400 spindles. Having 180 to a frame gives 10,400 divided by 180, equals nearly 57 speeders. We call it 58, so as to give one spare speeder to enable the carder to manipulate his drafts, and regulate the work between the fine speeders and intermediates, and to also accommodate the spinner in the winter time by allowing him to shorten his drafts and thus improve the work by removing a great amount of friction from the front rolls which makes the yarn uneven.

During a certain part of the year, especially in the month of October, the spinning runs badly. This is the time that the spinner and carder should get together and arrange the drafts in each room so as to remove friction from the spinning top front rolls as much as possible. This is accomplished by shortening the drafts.

No doubt, many readers will not agree with us, because to those who have not given the above point due consideration, it may at first seem a matter of little importance.

To prove the above, figure the draft of a frame when it is excessive, and you will find that the strand in front of the machine should be lighter. In some cases, it proves much heavier than the calculated draft.

The reason for this is that the front roll has so much work to do, owing to an excessive draft, that it lags behind the speed of the bottom steel roll, which, of course, shortens the strand, or in other words, if the figure draft is seven, it stands to reason that by the front top roll lagging behind the bottom steel roll, a draft of seven is not attained and the work is heavier.

On the other hand, if the draft is short, it will be found that the draft will very nearly prove itself by dividing the hank fed into the hank produced.

Our forefathers used the following rule to advantage: Divide the hank fed into the hank produced to obtain the draft. But very few use the rule now, and why? Some will tell you that the rule cannot be used accurately, owing to the insertion of twist.

It must be admitted that the twist found in most slubber roving affects the hank but little; but here is where you will find the greatest variation. We are not now referring to a slubber with a short draft; but we mean that when a slubber has a draft of at least five, which is considered a short draft by some carders, divide the hank fed into the hank produced and it will be found that the draft will prove shorter than it figures.

This is the reason why the above rule is not used to advantage at the present time. It is the friction by

THE EXCESSIVE DRAFTS

found in most of our cotton mills that makes the variation, and not the twist, as many believe, although we are willing to admit that the twist will affect the weight of the sliver slightly.

Years ago, you would find a draft of 14 on ring frames in very few mills, Drafts were found to be very short. Of course, the drafts in the card room were excessive. This was because in those days we had the railway head system, and, owing to the bulky sliver which had to be run in order to get the production, the drafts had to be excessive to draw this bulky sliver down. In the spinning rooms, the drafts were shorter than at the present time.

It must be understood that a series of short drafts can be found at the present time in some of our mills, especially in our fine goods mills, but in the majority of our mills you will find the drafts excessive, with an excessive front roll speed besides. This makes conditions so bad, and so much waste is made, that it gives a visitor a desire to roll up his trousers in walking through the alleys.

We next consider the number of jacks to supply 82,800 filling spindles. A ring frame spindle running 45s yarn should turn off .70 pounds per spindle. 82,800x.70 equals 57,960 pounds. A jack spindle running 6.50 hank roving should turn off about six pounds per week. 57,960 divided by 6 equals 9,660 spindles. 192 spindles to a frame, 9,660 divided by 192 equals 50 speeders, so we call it 52 speeders for reasons previously explained.

A SPOOLER SPINDLE

running 28s yarn should turn off about 18 pounds per week. 104,000 divided by 18 equals 5.777 spindles. 100 spindles to a spooler, 5,777 divided by 100 equals 57.77, or 58 spoolers. A warper should turn off about 2,600 pounds per week. 104,000 divided by 2,600 equals 40 warpers.

A slasher running at a proper speed should turn off 12,000 pounds per week. 104,000 divide by 12,000 equals nearly nine slashers. Four thousand looms should be installed to weave the yarn from the above organization.

On one side of the cotton shed the spaces should be lettered. Cotton of the same mark is placed in the same stall. With such an arrangement, one bale can be taken from each lot at mixing time so as to mix the different marks.

The side of the shed that is not marked is supposed to be empty, and ready to receive new cotton, thus it can be seen that while one side is being emptied, the other is being filled. A cotton shed should be built high enough so that a second floor can be built to store away any surplus bales of cloth. The shed should be built as close to the picker room as possible, so that very

LITTLE TRUCKING

will be necessary to bring the bales in the range of the hosiery apparatus.

The door where the cotton is admitted to the picker room should be at least twenty feet above the floor where the cotton is mixed.

A platform should be built even with the door, and made wide enough so that a bale of cotton can be laid lengthwise. With such an arrangement, the bales could be hoisted to this platform and laid on the platform opened and mixed when another lot would be brought in in the same way.

It must be understood that the number of bales laid on the platform at one time would be governed by the number of marks, or in other words, one bale of each mark is brought in and laid on the platform and mixed, when this is again repeated until the necessary number of bales are mixed.

In this way, it can be seen that

BLENDING THE BALES

would not be left to the men doing the mixing, and this arrangement precludes the possibility of two bales of the same mark coming together. Of course, it should be seen that in order to do this, when a mark is brought in from the first lot and put on one side of the staging, that the next time it must be placed on the opposite side, and the next time in the centre, and so on.

If possible, a railroad branch should come between the shed and the mixing room for shipping facilities, for cotton, waste and cloth.

There is one criticism that can be made in all picker rooms, and that is, where a large floor space is left for

mixing, the operator of the automatic feed boxes has to walk a considerable distance for the cotton when the mixing is running low. Some mills use what is known as the Bourne platform, which moves the mixing closer to the machines as the mixing runs low. With the above arrangement, it can be seen that instead of throwing the cotton upwards after mixing a few layers, the cotton is thrown down, and in this way the cotton can be built very high, which enables a large mixing in a small floor space. The operator would at any time have very little walking to do.

By the plan, it can be seen that eight finishers are placed on one side of the picker room door and eight on the other. A track that runs from this door to the full length of the cards, on which a truck runs that can carry eight laps at a time, makes it easy for the lap carriers to carry their

Picker room and card room lay-out.	Number of frames.	Number of blades.	Blows struck to the inch.	Diameter of beaters.	Revolutions of beaters.	Revolutions of fans.	Weight of lap and sliver.	Hank.	Revolutions of card cylinder.
Automatic feeder and breaker	12	3	20	18″	950	1,000	11 oz.	.0017	
Inter. picker	16	2	23	16″	1,250	950	11 oz.	.0017	
Finisher	16	2	37	14″	1,440	900	11 oz.	.0017	
Filling card	120						50	.166	165
Warp card	120						60	.138	165
Filling drawing	60						50	.166	
Warp drawing	60						60	.138	
Filling slubber	12						12.8	.65	
Warp slubber	12						13.8	.60	
Filling inter.	24						4.16	2.00	
Warp inter	24						5.04	1.65	
Fine speeder	58						1.85	4.50	
Jack frame	52						1.25	6.50	

Picker room and card room lay-out.	Diameter of cylinder.	Diameter of doffer.	Revolutions of doffer.	Draft.	Twist per inch.	Coils to the inch.	Revolution of front roll. Metallic rolls 1⅜″ dia.	Revolution of spindles.	Gauge.	Number of spindles.
Automatic feeder and breaker										
Inter. picker										
Finisher										
Filling card	50″	27″	11	91						
Warp card	50″	27″	12	77						
Filling drawing				6			400			
Warp drawing				6			400			
Filling slubber				3.91	.81	6	165	630	12″×6″	80
Warp slubber				4.35	.78	5.8	173	630	12″×6″	80
Filling inter.				6.15	1.56	13.43	132	850	10″×5″	102
Warp inter.				5.5	1.41	11	140	850	10″×5″	102
Fine speeder				5.5	2.55	22.27	128	1,150	7″×3½″	180
Jack frame				6.6	3.05	31.86	120	1,300	6″×3″	192

laps; moreover, the laps are not injured as when they are carried by hand.

This arrangement saves waste, which is usually made when the laps are carried by hand, as it is well known by all experienced men that when the strippers carry the laps by hand, as most of them will carry two at one time, and when this is done, the surfaces of the laps are injured to such an extent that a sliver has to be pulled off each lap. Therefore, this amount of waste must be run through a second time, which makes this stock fluffy.

It can be seen that, in the manner in which the cards are placed, much floor walking is saved for the strippers when they break out the cans, as the last card is only four cards away from the drawings. (1) It enables a stripper to run more cards. (2) It saves the cans, because when cans have to be carried a long distance to the drawing, they are made to slide over the floor and the nails that protrude from the floor soon injure the can bottoms.

As can be seen from the plan, the slubbers are placed directly in front of the finished drawing, and the intermediates next to the slubbers. The fine and jack frames are placed on the second floor for reasons that will be explained later.

We will call the picker room end of the mill north and the other end the south. By the plan, it can be seen that on the first floor of the north end we have 240 cards, 120 heads of drawings, 24 slubbers, and 48 intermediates. The only objection offered against the above plan is that the picker room is too far from the last card near the centre of the mill. But with three lap carriers, the inconvenience of the above arrangement can be overcome without greatly increasing expenses. The strippers can each handle 20 cards. They carry no laps. The first lap carrier could easily take care of the first 40 cards near the picker room door by carrying the laps by hand, one at a time, while the other two lap carriers could take care of the other 200 cards by working together with the truck.

Even if an extra hand was necessary, consider what we save in another way. On the second floor, we place 58 fine speeders and 52 jack frames, thus making a

MODEL SPEEDER ROOM.

The reasons for placing all fine speeders by themselves are numerous, but the chief reasons are (1) when they are in the same department with the cards, drawing, etc., the fly that is about the room continually collects on the creels, and when it is brushed off, it generally collects on the ends in front of the speeder, unless the frame is stopped when cleaned. (2) If fine speeders are placed with ring spinning frames, the heat that the ring frames occasion makes it necessary to insert more twist in the roving, or otherwise the roving will be spongy and much running over and under will take place.

The above is a practice found in many of cur latest mills, and that is where a

MISTAKE IS MADE.

We said at the beginning of this article we would prove that it is necessary for a man who has charge of building a mill to consult agents and overseers of the different departments of other mills.

If all mill engineers knew the harm that is caused by placing fine speeders in the same room with ring frames, you would not find so many of these machines running side by side. The writer has for seven years run fine speeders in a ring spinning room, and the only way they could be run successfully was by inserting two extra teeth of twist in the roving.

So on the second floor of the north end we have the fine speeders, with a stairway at each end and one in the centre, leading down to the card room. The carder has all his departments at one end of the mill, and a good man can run these departments easily. On the top floor of the north end, we place 342 ring frames of 256 spindles. On the top floor of the centre, we have the spooling and warp-

ing. On the second floor of the centre, we have the slashing and drawing-in room.

On the lower floor we have the machine and carpenter shop. The slashers are placed over the machine shop. The reason for this is that

MUCH DAMAGE RESULTS

to textile machines when they are placed in the room below the slashers from the water which often comes through the floor, from an overflowing kettle, pipes, etc.

On the first and second floors of the south end, we place 4,000 looms, 2,000 looms in each room. On the top floor on the south end, we place 324 ring frames of 256 spindles. On the west side of the filling room, we have a filling tower where the full bobbins are dumped after doffing. At the bottom of this filling tower, at a point between the two weave rooms, we place a humidifier to dampen the filling to prevent it from kinking. The humidifier would, of course, have to be of such a type that the amount of humidity to the square foot would regulate the spray. Humidifiers would also be placed in every department excepting the first and second floor of the centre.

It can be seen that there would be ample room to store the reeds and harnesses in the slasher room, but this storeroom should be divided from the slasher, so that the exhaust steam will not find its way to the reed wire.

The above point should be noticed by many mill men, because often you will find in many slasher rooms hundreds of reeds that have become so rusty they are unfit for use.

With the above equipped mill, it is safe to say that the cost of manufacturing a yard of cloth would be much below the cost found at the present time in many of our cotton mills. The overseers in charge must give their respective departments proper attention. They must be men who can give personal attention to the most important details, and at the same time realize which part of the work should be taken care of by their assistants.

Each of the departments for the above mill are about as large as can be economically handled by a single overseer. In this one it is true that the cotton must be carried a considerable distance. The cost of employing an extra man for carrying laps is small, however, and the above layout can be operated satisfactorily and economically.

[Article Number Two — Replying to Article Number One]

In the American Wool and Cotton Reporter for June 22 we printed an interesting reply to your question which had previously been asked concerning the most convenient size for a cotton mill. The exact wording of our question appears at the beginning of the article referred to, which was published under the heading "Proper Size of a Cotton Mill." We print below some comments called forth by this article. The article published in the June 22 issue of the American Wool and Cotton Reporter under the heading "Proper Size of a Cotton Mill" contains many interesting and valuable points.

The author of the article states that a cotton mill should not be much over 90 feet wide, but at the same time shows for illustration a plan of a card room equipment which would call for a room at least 112 feet wide. Attention was called to the fact that cotton must be carried a considerable distance in taking it from the picker room to the cards farthest away, and the author maintains that this disadvantage is more than outweighed by the various good points of his typical layout.

Two hundred and forty cards, arranged as shown in the illustration given on page 3 of the June 22 issue,

would need a room approximately 710 feet long. This 710 feet is a rough figure obtained by calling all the alleys between the ends of the cards 3 feet to be arranged as shown in the illustration given in the June 22 issue, there will be 60 groups of 4 cards each. Without allowing for any al-

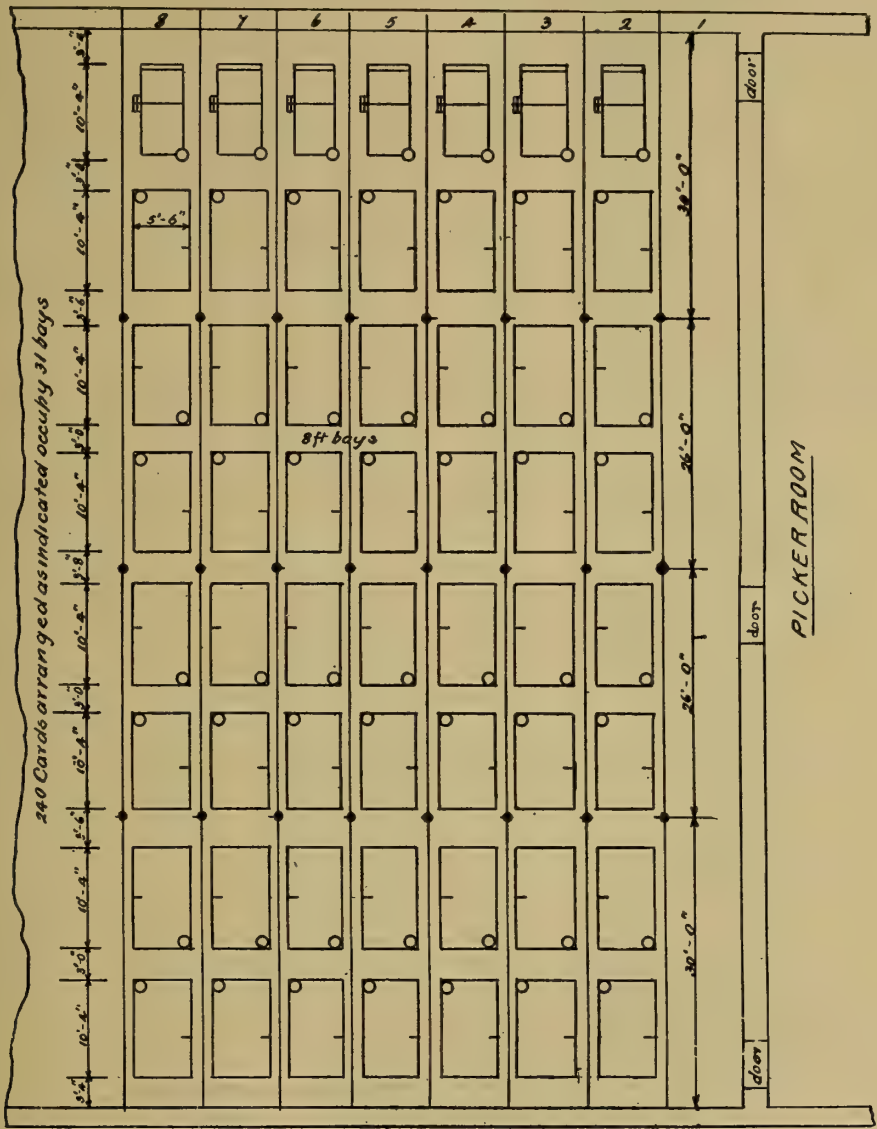


Fig. 1. Arrangement of Cards.

and the length of each card 10 feet 4 inches. There should be some alleys wider than 3 feet and this would make the room still longer. If 240 cards are leys, the cards alone will need a space 60 times 10 1-3 feet or 620 feet long.

If we allow three feet four inches for the width of each intermediate

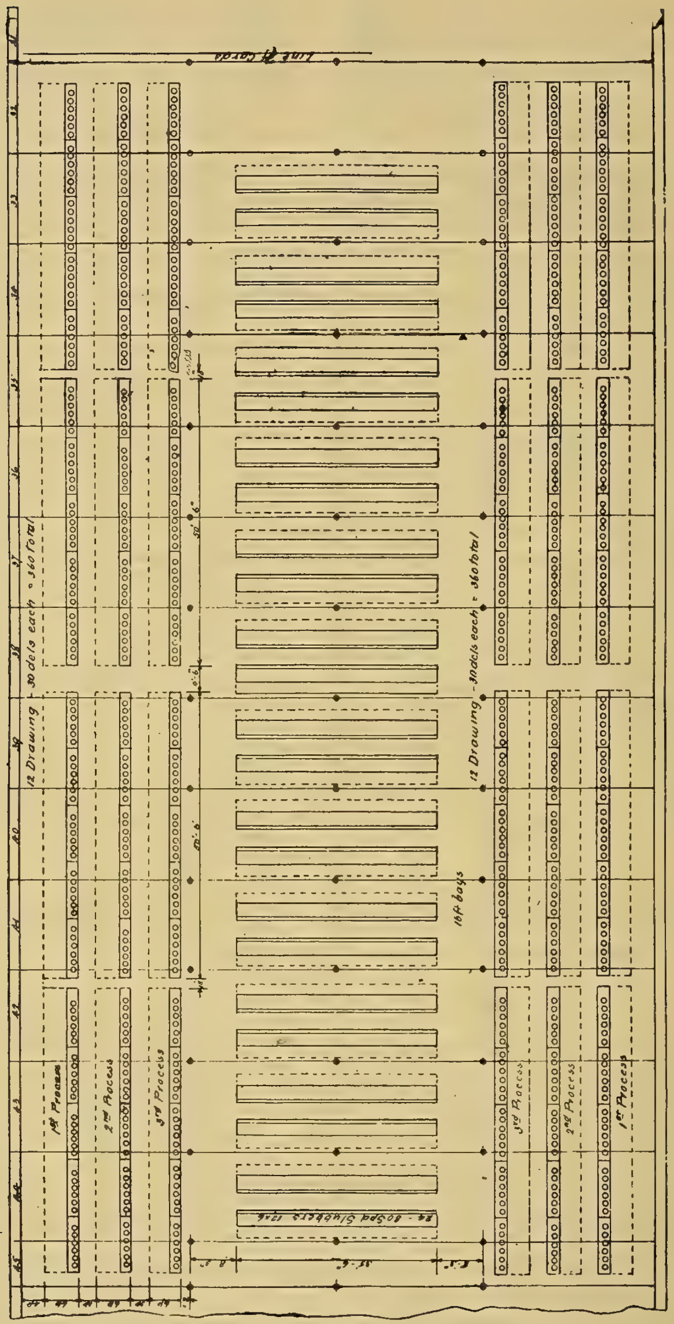


Fig. 2. Arrangement of Slubbers and Drawing Frames.

frame and arrange them as was indicated, the space needed for the frames without alley space would be about 160 feet. If a space of three feet was left between each intermediate, the 48 frames would extend only 307 feet lengthwise of the room.

In other words, a room long enough to contain the 240 cards, as arranged in the illustration previously shown, would be about 400 feet longer than that needed for the number of intermediate frames recommended. None of these figures need be followed exactly, but it is evident that the layout would not fit in properly in the manner indicated by the author of the article.

MOST CONVENIENT MILL SIZE.

In considering the most convenient size of a cotton mill, the article published June 22 takes the stand that all card room machinery for the mill must be placed in one room. The one point on which emphasis is laid is that of providing one man who can properly supervise a large room.

If by the expression, "the most convenient size for a cotton mill," you mean the most convenient size for one mill room, we feel that the arrangement outlined is not the most economical. To obtain proper illumination, it is not wise to build a mill room too wide, and the figure 90 feet mentioned in the issue of June 22 is approximately correct. There would be no trouble, however, with a mill slightly over 100 feet wide. It is generally advisable to place drawing machinery across the mill. The length of the drawing frames frequently determines the width of the mill room.

With every possible convenience for moving the product from one machine to another, it may be economical to install 240 cards and the corresponding card room equipment in one room. In more instances, it would not. It is sometimes practical to arrange drawing machinery lengthwise of the mill, but to place in one room card room machinery needed for a mill like that described in the June 22 issue would seldom be practical. Too much carrying of the product would be necessary. The exact limit to the amount of equipment which should be put in one room depends upon methods of handling the work in process and local conditions which affect the size and shape of a mill. The economical size of a card room is limited by the machinery arrangement and not by the question of proper oversight.

In the card room, there are two or three kinds of

DRAWING MACHINERY,

that is, the first process frames, second process frames and third process frames, where the latter are used. The sliver from the cards must go to the first process drawing, then to the second and then to the third. The machinery must be carefully arranged to prevent mixing cans from the different processes. This limits considerably the number of practical machinery arrangements. Figures 1, 2 and 3 show different parts of a card room containing the machinery suggested in the article which appeared June 22. Figure 1 is a portion of the room next to the picker room and illustrates a proposed arrangement for 240 cards. These will use 31 eight-foot bays. The bays are numbered in each of the above figures. These three illustrations show an arrangement which is more practical than that given in the article referred to. We would not recommend putting so much machinery in one room, but if this was necessary, would advise the arrangement shown.

The 240 cards arranged according to Figure 1 require a mill about 112 feet wide. Leaving one bay vacant between the cards and the picker room, this process will extend to the end of bay 31, as indicated in Figure 2. With this arrangement of cards, there is no long distance to carry laps from the picker room. This objectionable feature of the arrangement illustrated in the June 22 issue was noted by the author of that article.

Figure 2 shows the section of the card room extending from bay 31 to bay 45. This part of the room contains the drawing frames and slubbers. The space required for a slubber and the necessary cans is about 5 feet. In order to place the slubbers in

pairs without having any posts between the fronts of the machines, every other column has been omitted from bay 31 to 45. This construction will increase somewhat the first cost of the mill, but it makes it possible to arrange the slubbers in a satisfactory way.

The first process

DRAWING FRAMES

contains 240 deliveries; 30 deliveries require a space of approximately 50 feet. Therefore, 240 deliveries, without allowing any space for alleys, would require about 400 feet. If we try to arrange the drawing across the mill, there would have to be several groups of each process drawing. This scheme has been tried and much trouble results from operatives mixing the drawing cans. In spite of various methods which have been tried, such as having first process cans one color, second process another, etc., operatives will frequently get into trouble by using cans which have not been through the proper drawing process.

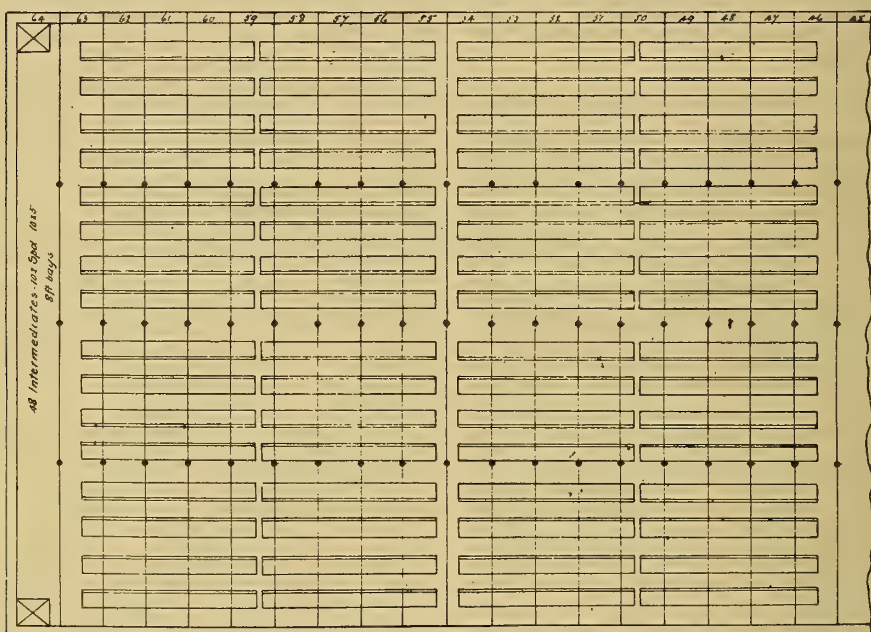


Fig. 3. Arrangement of Intermediates.

If we should arrange the drawing lengthwise along one side of the mill, it would mean that some of the sliver from the cards would have to be carried at least 400 feet to reach the further end of the drawing machinery. In Figure 2 the drawing has been arranged in two groups placed lengthwise of the mill with the slubbers between them. With this layout, the longest distance that sliver from the cards must be carried is slightly over 200 feet. By placing the slubbers as indicated in Figure 2 they will occupy practically the same distance lengthwise of the mill as the drawing frames.

AMPLE SPACE

is left for cans between the ends of the slubbers and the drawing machinery. All the cans which will be around the slubbers contain sliver which has received its three drawings.

As indicated by Figure 2, the drawing machinery and slubbers end at bay 45. Figure 3 shows the remainder of the card room extending from bay 45

to 64. This space is occupied by the 48 intermediate frames. Two or three elevators should be placed at the end of the intermediate frames for conveying the partially finished yarn to an upper floor.

The layout illustrated by Figures 1, 2 and 3 has many faults, but seems as satisfactory a one as it is possible to obtain where so much card room machinery is placed in one room. The product from some of the slubbers has to be carried nearly 190 feet, and sliver from some of the cards must be carried approximately 250 feet. If such a mill were to be built, it would be most important to use modern methods for conveying the products from one process to another. With this idea in mind, wide alley spaces have been allowed.

With the arrangement indicated in the June 22 issue of the American Wool and Cotton Reporter, although some of the laps for some of the cards had to be carried over 700 feet, the main objection to the layout was the fact that the different machinery did not require the same space lengthwise of the mill. That is, the cards spaced according to the illustration needed nearly 400 feet more space than the intermediates.

For a mill this size, would it not be much more advisable to place the card room equipment in two, or, if found necessary, in

THREE DIFFERENT ROOMS?

These could be placed on three floors of one mill, cotton from the picker room could be elevated to the two upper stories, and with smaller layouts the machinery could be arranged more satisfactorily.

The expression "one cotton mill" need in no way mean that all cards, drawings and speeders must be placed in a single room. Assuming that the machinery is arranged most conveniently in rooms of suitable dimensions, there is no reason why one management and one central power unit should not operate a mill much larger than one containing 85,000 spindles. The question of the largest economical department over which one man can have supervision is a distinctly separate question from that of the largest economical cotton mill.

In speaking of the disadvantages of a small mill, the article referred to gives facts which hold true for the smallest plants, but which do not for the medium-sized cotton mills which might be considered small in comparison with the plant outlined. For example, it is true that in very small mills the absence of some men from work might cause the overseer to give too much of his time to detail work. This should not be necessary, however, in mills which are neither considered very small nor very large. It is not fair, therefore, to compare the exceptionally small plant with the exceptionally large one, unless we remember that those, say, of 50,000 spindles must be considered as still another class.

A picker room with 12 breakers arranged side by side should be at least 120 feet wide. There would not be much objection to having the picker room wider than the main mill, excepting that with the wide room the light would be poor. There is no need, however, of the opening machinery being placed in the same room with the finisher pickers. The location of the openers should be governed by the location of the cotton storehouse. The location of this building should be governed by the railroad track and other

SHIPPING FACILITIES.

The cotton can be opened in rooms considerably distant from the main mill and then delivered to the other building by use of conveying systems which have been recently illustrated in the American Wool and Cotton Reporter. Under certain conditions the storehouse may be located so that it will be advisable to have the opening and picking room connected to the main mill, but the flexibility of modern conveying systems makes it possible to locate the opening room at any desired part of the plant, irrespective of the location of the other machinery.

Near the latter part of the cotton mill article, which appeared in the June 22 American Wool and Cotton

Reporter, the statement is made that 4,000 looms should be placed upon the first and second floors of the south end of the main mill. Weaving rooms should be so designed that the illumination may be well distributed. Most new mills are placing looms in one story saw-tooth weave sheds. We would not say that the one-story weave sheds are always the most advisable buildings for looms, but the ordinary mill having 2,000 looms on one floor would not be satisfactory.

The Maverick Mill at East Boston has a large new weave shed, 340 by 231 feet. This room contains 1,000 looms and is one story, having a saw-tooth roof. Consider for a moment the length of a room about 100 feet wide which would hold 2,000 looms. For round figures, assume that the mill illustrated in the June 22 issue was 100 feet wide. The floor space used for 1,000 looms at the Maverick Mill is 78,540 square feet. According to this arrangement, 2,000 looms would need 157,080 square feet, and a room only 100 feet wide would need to be 1,570 feet long.

[Article Number Three — Replying to Article Number Two]

I have read with interest the criticisms of my article entitled "Proper Size of a Cotton Mill," and for the sake of knowledge and justice to myself I could not let such criticisms pass unnoticed. If the readers of the American Wool and Cotton Reporter will refer back to my article, they will notice that I have not given any dimensions in the construction details or machinery for equipment. When the article was written, the writer had in mind economy only, as this was the vital part of the question, and for this reason I did not dwell on any dimensions. Again, the proper location of the machinery was demanded, and the writer pointed this out to the best of his ability, at the same time having economy in mind.

If the reader will refer back to my article he will find that the writer does not confine himself to a 90-foot width mill, but instead states that, in order to eliminate as far as possible the use of artificial light, it is seldom advisable to erect mills much wider than 90 feet.

The writer could have pointed out at the time of writing the advantages of the machinery indicated in the article by giving dimensions, but as the article was so long, the writer feared that space would not permit, so confined himself strictly to the questions, namely, "the most convenient size for a cotton mill both respecting the proper location for machinery and the work of overseeing."

All readers must agree with the writer that in order to answer these questions properly it is necessary to write at least a good-sized volume. First, to give all dimensions alone of the mill in question would have taken an enormous amount of space, and second, to explain the duties of overseeing each department would certainly require every column of a single issue of the American Wool and Cotton Reporter. So, with the above in mind, the article was written, and no one is better pleased with the criticisms found in the July 20 issue of the American Wool and Cotton Reporter than the writer.

It is not the writer's intention to show up his critic, for the writer is ready to admit that he had plenty to criticize, but he did so from a theoretical point of view, and for this reason overlooked the economy derived from the proper

LOCATION OF MACHINERY

that can only be understood and kept in mind by men of practical experience. Now let us all give our atten-

tion to some of the dimensions, and at the same time let us reason together and determine whether in some cases it is economy to have a mill wider than 90 feet.

Let us now consider the arrangement of the machinery indicated in my article. By referring again to my article, it will be noticed that the cards are positioned sideways. So with such an arrangement, it is not necessary to have space enough between the cards to allow the stripper to pass through, because, at the most, he would have to come around only the distance of two cards. So, for this reason, we allow only two inches between the cards which is necessary to place the belt on and off the card pulley.

Allowing three feet from the wall to the first card, which gives a large enough alley, and assuming 5½ feet for the space of each card, plus two inches between cards for space, we have 4 times 5½ equals 22 plus 6 inches equals 22 feet 6 inches. Allowing two feet between the cards and drawing frames gives 24 feet 6 inches.

A DRAWING FRAME,

including cans, occupies a space of 5 feet three inches—10-inch cans. Allowing a space of 2 feet between each process and a space of 2 feet between the drawings and slubbers, we have 5.3 times 3 equals 15 feet 9 inches, plus 6 equals 21 feet 9 inches, 24 feet 6 inches plus 21 feet 9 inches gives a distance of 46 feet 3 inches from the slubber cans to the wall on the card side.

The space occupied by a slubber having a gauge as found in the table of my article is 5½ feet. Allowing 3 feet for the slubber alley and 3 feet from the slubber cans to the intermediates, we have 5½ times 2 equals 11 feet plus 6 equals 17 feet. This added to the distance previously found gives 63 feet 3 inches. The length of an intermediate of 102 spindles having the gauge given in my article is about 31 feet. Allowing a window alley of 3 feet, we have 34 plus 63 feet 3 inches, gives the total width of the mill, 97 feet 3 inches.

Now, let us examine the layout given in my article, and then let us examine the arrangement of intermediates in Figure 3 of the critical article, and consider the

ADVANTAGES OR DISADVANTAGES

of each. Here we find in Figure 3 the very mistake that is well understood by most every second hand and overseer, and one that is entirely eliminated in the layout in my article.

With the arrangement given in Figure 3 a mill of 90 feet would be too wide for dull days, because when the speeders are so arranged the creels shut off much light. The writer himself has had charge of a room 90 feet wide with the speeders arranged as indicated in Figure 3, and he remembers well that on dull days it was necessary to artificially light the centre of the room. Many readers have no doubt experienced the same, and it is strange, when you stop to think, that the majority of mills have their speeders arranged as indicated in Figure 3.

Now, why are speeders so arranged by our expert mill engineers? I will tell you. It is because these men obtain their knowledge only from colleges and textile schools. The writer does not want to be misunderstood as being against either institution named above. Far from it, because he is a graduate of one himself.

But the writer will prove below that the machinery in most cases is improperly arranged through lack of experience in every-day practice. Ask any experienced carder his objections to the arrangement in Figure 3, and he will answer you that besides making the room much darker all the speeders in the window alleys are much more difficult to operate. First, when the sun is on the side of the mill, the speeders nearest the windows will run much slacker in the summer months, which makes spongy roving, and, too, the roving in the creels is somewhat affected. No experienced man will argue on the above, because it is a well-known fact that the speeders in the window alleys of every mill where the speeders are so arranged require more rack gear changing.

In the winter conditions vary so that they must be changed again, although the writer is willing to admit that more trouble is experienced in the summer. However, it must be admitted that this is not so liable to happen with the layout given in my article, because, in the first place, only the end roving in the creels are affected, besides the cone belt is brought to a greater distance from the windows, which insures a

MORE UNIFORM TENSION

on the speeders. A great many readers may doubt the above, and may be a bit skeptical about the sun affecting the running of the speeders in the window alleys, but is it not a fact that the steam pipes are now placed at the ceiling instead of at the lower side of the mill wall for this very reason?

Although other reasons can be advanced, spongy roving in the window alleys was the beginning of it. In the second place, when speeders are so arranged, it is impossible to open windows when the conditions of the room demand it, because if the draught is very strong, the ends on the frames nearest the windows will be blown into one another. The writer has experienced the above, and no doubt many readers have also. The critical article states that there would be no trouble with a mill slightly over 100 feet wide, and at the same time, gives us a layout where trouble is experienced in mills of only 90 feet wide, and the writer can give the names of two mills 90 feet wide that are now having trouble with dark centre alleys on dark days.

Continuing, it also states that the length of the drawing frames frequently determines the width of the mill room, but the chief disadvantages of such a layout are not considered by the article, and let me say that, although this has been the vogue among mill engineers to determine the width of the mill room by the length of the drawings, it is a mistake, and as the article fails to point out the chief disadvantages, I will do it.

The chief objection in arranging the drawings crosswise is that the card slivers must be carried a greater distance, and when so arranged can boys must be employed, or extra strippers.

The next objection is the great amount of injury that is sure to result to the can bottoms by sliding the cans over the floor for such a distance. This is explained in my article and pointed out how the nails that protrude from the floor injured the can bottoms.

Regarding mixing the drawing, which is given as an objection for laying the drawing crosswise, let me say that I have run a card room many years and never experienced such trouble with the drawing frames arranged crosswise. When drawing is mixed, it is due to carelessness on the part of the overseer in not giving the help proper instructions or not looking after his business. Although the writer is willing to admit that drawing may get mixed by a green hand, on the other hand, such help should not be left alone until able to properly arrange the cans from every process.

The critical article gives us an arrangement in Figure 2, where it is admitted that the longest distance the card sliver must be carried is slightly over 200 feet. Now, just think of it, how long will drawing cans last when they are made to slide over

A ROUGH FLOOR

filled with nail heads, and besides, as the floor boards run across the mill room, this also aids in jarring the cans so that sooner or later the bottom falls out, and in some cases even the smooth rings at the top of the can are pulled out. The writer in his mill life has repaired so many hundred cans that this was the starter in laying the cards out in the manner given in my article, for it is a well-known fact that in most mills instead of repairing the defective cans they are taken to the fire room.

Of course, it must be understood that the writer had other advantages in mind besides the above when arranging the layout. With the layout given in my article, the card sliver would not be carried from its longest distance 50 feet, because the last card is only 24 feet 6 inches away from the drawing cans, and surely 26 feet is enough to give every opportunity to

lay the drawings along the cards. Again, when the cans are pulled from the coiler to the floor, they are pulled over the floor in the direction that the floor runs, and when the short distance is taken into consideration, together with a smooth floor, it must be admitted that the layout given in my article is most economical. With such an arrangement the strippers are able to run 20 cards, while in the arrangement given in Figure 1 of the critical article the strippers are able to run only 16 cards. Is not the above an expensive item? Another strong objection to the layout in Figure 1 is the increased liability of the cards getting wet in case of fire on the floor above them. With the layout given in my article, if a fire should occur on one end of the mill it must be admitted that the number of cards that would receive a wetting is small compared with the arrangement given in Figure 1.

It should be seen that if a bad fire occurred on the next floor above the cards arranged as given in Figure 1 the majority of them would receive a wetting that perhaps would necessitate the shutting down of other departments temporarily, which often results in the loss of a large order that must be delivered within a certain time. Besides, when cards receive a wetting once they do not card the same afterward, because the wire becomes rusty and clings to the staple more, which makes it difficult to strip the card clean. Besides, the doffer comb teeth become rusty also, and every practical man knows the amount of trouble this will cause.

Even if the above liabilities are not considered, the expense of extra strippers and can boys, besides the injury to the cans, should be enough to convince the most skeptical that the layout in my article is the most economical. Again, let the reader place the layout given in my article before him and just consider how such an arrangement allows the light from the windows to reach the centre of the room. And let me ask the reader if more light is not obtained from the arrangement given in my article than that given in Figure 3 of the critical article, even though the mill was 112 feet wide, as found in the critical article. In my article the drawing could be arranged the full length of the cards and at the same time give ample room between the groups of heads of drawings for spare cans, a point that is overlooked by most mills, as this is necessary, because it is impossible to so arrange your drawing drafts so that one process will balance with another continually, and for this reason, you will find the above defect in most mills, where the drawing frames are obliged to stop for cans.

It must be remembered that when the frames are stopped the drawing tender's pay is going on, but it seems that this is given very

LITTLE CONSIDERATION

in our mills. Now, can any reader deny that drawings are not obliged to stop for spare cans in many mills? Is not this an expensive item? Why do we have spare bobbins on our speeders? Is it not to balance one process with another? And, mark you, the loss on speeders is not suffered by the mill, but instead by the speeder tender, because speeder tenders in most mills are paid by hanks, while drawing tenders are paid by the hour. It must be admitted that all I have pointed out in favor of my layout is true—ask any experienced carder. We should have much space also between our

SLUBBERS,

but is it not necessary to have roving and bobbin pins? Besides, it is necessary to have floor space enough for roving boxes and spare cans for the slubbers.

The critical article points out also that my illustration shows a room about 400 feet longer for the intermediate layout than that needed for 240 cards arranged in the manner given in my article. Now, in order to place fine speeders in this space, it would be necessary to make the width of the mill at least ten feet wider, and, besides, the objection in having fine frames in the same room with the cards and drawing was pointed out; this is why the writer placed the intermediate frames away from the

cards and drawing as much as possible, and at the same time close enough to the slubbers so as to save floor walking for

THE INTERMEDIATE TENDERS.

Just a glance at Figure 3 is enough to convince any practical man that the speeders in the figure were arranged by one who lacks knowledge in the every-day operations of a card room. Look at the figure and just think how far the slubber roving must be carried, then refer back to the layout in my article and please note the difference. What does this mean to the extra cost of a room? It means that you must at least have two roving hoisters, because you could not expect an intermediate tender to leave the speeders and go hunting for roving at such a distance. Just think of the damage that this arrangement is liable to cause. At the present time in our mills we have no back tenders and so when the tender leaves her work the speeders are at the mercy of the power if anything goes wrong. Now, let us assume that while the tender has gone on the hunt for slubber roving a hard end comes through and pulls a flyer from the top of the spindle into the other revolving spindles and see the amount of damage that may result to the flyers, gears and bolters.

Again, suppose a cone belt broke. Just think what a mess this would make if other tenders were busy with their own work and not around to stop the frame. Suppose there was a fire, would not much damage result if no other tenders happened to discover it. All the above results in an expensive card room, and although all the above defects do not happen often, they do happen, and in some cases they are costly even when partly covered by insurance. Now the writer does admit that with the layout given in his article, there would be too

MUCH SPACE LEFT

for the intermediates. In fact, all fine and jack speeders must be placed on the same floor with such a layout as given in my article. Now, as the writer gave no dimensions, he placed the fine frames on the next floor to point out to the readers the disadvantages of having the fine speeders in one room, but, as I stated at the beginning of this article, had the writer given any dimensions, he would have been forced to place all the speeders on the same floor. But that does not affect my layout; all that is necessary for the reader to do is to consider the intermediates given in the drawing as intermediates, fine and jack speeders. Of course the mill must be made 8 feet wide, which would bring the width of the mill to 105 feet 3 inches. But even with such a width my layout would allow me more natural light to reach the centre of the room than that given in Figure 3.

In placing all the speeders on the same floor, the fine speeders would have to be

ARRANGED IN GROUPS

of six between each pair of intermediates—not a bad layout at that, when economy is considered, as such a layout would not require hoisters.

From what has been said above, it must be admitted that the layout in my article is an ideal one, except that the fly about the room will collect on the fine frames, which can be remedied, and it will be explained later.

But it should be seen that as the writer gave no dimensions, and at the same time having his mind centred on conveying the valuable points in having all the fine speeders in one room, he gave no consideration to the exact layout to properly fit the card layout as indicated in the article.

The writer claims that he is well within bounds when he claims that the layout given in the article is

THE MOST ECONOMICAL

even though the fine speeders are placed on the same floor. So in building a mill it is the length of the speeders that should be considered, and not the positions of the drawings, as pointed out in the critical article, because, no matter how long or short you make a line of drawing the cost is not reduced, as drawing tenders will run only a certain number of deliveries for a certain wage, while on the other hand, the longer the speeders the more the cost is reduced.

So from the above it can be seen that it is economy to build a mill at least 105 feet wide with the machinery arranged as indicated in my article. If the machinery is arranged as given in Figures 1, 2 and 3, in the critical article, the mill should not be over 85 feet in width

But the reader is asked to stop here and study the two layouts from what has been said above, and when this is done he will arrive at the same conclusion as the writer, that is, he will be convinced that with the layout given in Figures 1, 2 and 3, of the critical article, it is necessary to employ either extra can boys or strippers to operate the cards, and at least two hoisters to bring and hoist the roving to the speeder tenders. While on the other hand in my layout an extra lap carrier only is necessary as pointed out in my first article. But just think what a

BEAUTIFUL LAYOUT

I give in my article.

Here we find that the stripper breaks out his cans and is obliged to take the farthest cans to a distance not exceeding 25 feet; then the easy sailing continues across the room.

Some may think from the layout that much walking is necessary from the last heads of drawing to the strippers farthest from the drawing. But let the readers examine my layout and consider the centre deliveries of the drawing going to the first slubber, and the end deliveries going to the slubber farthest from the drawings, and he can readily see that the amount of walking necessary to carry the finished drawing to the farthest slubber is not as great as one would suppose from a quick examination of the layout.

Next we have a pair of intermediates and then a group of six fine frames, thus making the layout so that the intermediates will come at the end of the slubbers. Of course the first pair of intermediates must be arranged past the head of the slubber, because six fine speeders arranged as indicated in my layout would take up a space of 36 feet, and as the length of a slubber with the gauge given in the table is 36 feet, it can be seen that by so placing each pair of intermediates a box of roving from the slubbers could handily be wheeled around the slubber end into each intermediate alley. Then the roving doffed from each pair of intermediates would supply the six fine frames, that is, the first pair of intermediates would supply the first six fine speeders and the next pair of intermediates the next six fine speeders, and so on, the full length of the mill.

The number of cards could be increased from 4 to 5 or even 6, but in doing this, we would have to either cut out one process of drawing or decrease the length of the speeders in order to arrange the speeders as indicated. Now every practical man knows that an extra process of drawings is a great advantage to any mill, because drawings, as a rule,

HAVE SIX DOUBLINGS,

and this, of course, greatly aids in remedying the slivers that do not contain the necessary doublings of lap and also defective places in the sliver, and for these reasons, we should double the strands and then draw them out at every opportunity. If the speeders are decreased in length the cost of the room is increased, and so we must accept the lengths of frames given in the table of my article as the most economical when the speeders are arranged as indicated in my article. So for this reason the writer advocates only four cards, no matter how much more space it gives in proportion on the speeder side, because the advantages of the layout are too many, even if we are forced to place the fine frames in the same room, which can be done with better advantage than first stated, that is, if the system of dust collecting for card rooms is used.

The above apparatus consists of a small tin pipe running above the machinery, with a down-pipe or connection over each card These connections are fitted with a patent hinged joint which also forms an automatic valve, and when the process of stripping is going on the valves are turned toward the cards.

When the valve is swung, or, in other words, straightened, the valve is automatically opened, and there is a strong suction on the hood covering the stripping roll, and when it is raised no air can enter the connections. If such a system was adopted with my layout, considering all fly frames on the same floor with other carding machinery, it must be admitted that the cost per pound of a card room with the layout given would be very low compared with that given in Figures 1, 2 and 3 of the critical article.

The critical article also states that the cotton can be opened in rooms considerably distant from the main mill and then delivered to the other building by use of a conveying system. Now, the writer is willing to admit that our

LATEST CONVEYING SYSTEMS

are valuable, but only in a case where it happens that the mixing is done in another building at a distance from the main building. This results often, of course, when alterations are made in a plant and the conveying system comes in handy so that every building in the yard can be used. Conveying systems are also valuable in conveying the stock from one floor to another. But in building a new mill no up-to-date practical mill engineer would advocate having this building a great distance from the main building, and again, it proves that the writer has had little or no knowledge in the every-day operation.

When cotton is mixed in most mills, all the lowest paid help, such as scrubbers, waste men, etc., are obliged to mix. The overseer of carding must examine every bale put in

THE COTTON BIN,

a feature that has been advocated by the American Wool and Cotton Reporter. The writer need not point out that to open enough cotton for such a size mill a large number of men are required many hours. Now imagine all this help to be some distance from the main building, especially the overseer, and something happens in the main building. There is not one reader but must admit that when the head of a room is missing at the time of a fire or accident many mistakes are made. Too often, when a fire occurred with the overseer out of the room, most of us have seen the help throwing a barrel of water when a pailful would have answered the purpose. An overseer of judgment, as a rule, hurries to the scene of a fire to prevent the operatives from throwing water on the fire, because it is well known by all mill men that the water used in case of fire must be applied with system.

For instance, in some mills brushes and pails are continually on hand so that when a fire occurs these brushes are soaked in the pail of water and applied to the ignited parts instead of throwing a number of pails of water that only strike the covering and glance off to the floor, very little if any water striking the fire.

So, for the above and other reasons, the overseer should have charge of only one building, and when there are two buildings there should be two overseers, as a man cannot divide himself, and it is necessary that the overseer remain in his respective room.

In the latter part of the critical article it points out that from example of the floor space occupied by 1,000 looms in the weave shed of the Maverick Mill at East Boston, Mass., it would require a mill 100 feet wide to be 1,570 feet long to place 4,000 looms in two rooms.

The writer evidently conceives the idea that it is almost impossible to pass the enormous amount of filling to the weavers. Besides, he is, no doubt, thinking of what a great distance the warp must be carried. If the readers will refer back to my article they will find that I advocated

FILLING TOWERS

where the full bobbins from the ring filling frames are dumped, and I also stated that the filling should be dampened with the use of a humidifier placed inside the tower. Now as I gave no dimensions I did not name the number of towers, but there should be a tower to every 1,000 looms, or, in other words, one tower to every 500 looms. on one floor. So the above settles the filling part of the question.

Now, regarding the warps, I would suggest that a small cable tower be built so that three cables would lead to three exits in the top weave room and also three in the lower weave room. Such a practice is being carried on at present. The Stark Mills of Manchester, N. H., have a cable cross the Merrimac river that carries a warp a distance of 750 feet in less than two minutes, so with such an arrangement we need not worry about making a weaving room 1,570 feet long, as the above figures assure us that a warp could be conveyed to the farthest point on the outside of the mill in less than four minutes, which is pretty quick time. Lastly, it must be admitted that in a large mill the number of looms to each weaver and fixer can be divided better. I do not claim to be right always, but I leave the reader to judge for himself between the two layouts given considering economy.

MECHANIC.

[Comments on the Three Previous Articles]

The subject "Proper Size of a Cotton Mill" is a tremendously broad one. and can well be divided into discussions concerning proper arrangement of machinery for various kinds of mills the maximum amount of machinery which can be properly under the direction of one overseer, the various local conditions influencing the size, shape and general arrangement of a cotton mill, and many others.

In the article published in the June 22 issue of the American Wool and Cotton Reporter, one point upon which great stress seemed to be laid was the maximum

AMOUNT OF MACHINERY

over which one overseer might have entire charge. The article seemed to argue that it was economical to install as much card room machinery, for instance, in one room as one man could handle. The writer brought out good points concerning the advantages of an overseer's work being confined to one room, but did not give sufficient attention to the disadvantages of placing so large an equipment of machinery in one room. Our comments and suggestions which were printed in the July 22 issue of the American Wool and Cotton Reporter were intended to call attention to this, and to show that while some points suggested in the June 22 article were desirable ones, some were also impractical or impossible, when the entire equipment of machinery was taken into account.

In the August 17 article, signed "Mechanic," the following statement appeared: "When the article was written" (referring to the June 22 issue), "the writer had in mind economy only, as this was the vital part of the question, and for this reason I did not dwell on any dimensions."

This is

AN EXAMPLE

of the way many people look on the matter of machinery arrangement for a mill. The arrangement of certain machines is decided upon without giving the entire question proper consideration. Mill men will sometimes say that they want the cards, drawing frames and slubbers arranged in a certain definite way in their mills, and will leave the rest of the machinery layout to the judgment of the engineer. If the mill man has considered the amount of space his proposed arrangement will occupy, and has given enough thought to the arrangement of the other necessary machinery, so that he knows it can be made to fit in satisfactorily, a good arrangement can be obtained. On the other hand, it is quite possible that he has

NOT GIVEN ATTENTION

to the amount of space occupied by the total equipment, but has simply determined that a certain number of machines will fit satisfactorily crosswise in his mill, or that a certain group of machines will work well placed in a certain way. His proposed arrangement may be a fine one, if it were not for the fact that the ar-

rangement of the other machinery must be given consideration at the same time.

For example, the writer signed "Mechanic" now states that on account of the difference between the floor space required for the 240 cards, as arranged in his article, and that needed for the intermediates, it will be advisable to place the fine frames and intermediates together. In his first article, the disadvantages of this very arrangement were considerably enlarged upon.

The writer signed "Mechanic" draws the conclusion that our comments were made from a purely theoretical standpoint. We realize that pure theory, as well as pure practice, has

ITS WEAK POINTS

and in our statements practice and theory have both been considered.

In the first column of page 1099 (July 20 issue) the following statement was made by us, referring to the machinery layouts suggested by our Figures 1, 2 and 3: "For a mill this size, would it not be much more advisable to place the card room equipment in two, or, if found necessary, in three different rooms? This could be placed on three floors of one mill; cotton from the picker room could be elevated to the two upper stories, and with smaller layouts the machinery could be arranged more satisfactorily." As stated at that time, the machinery arrangement illustrated by Figures 1, 2 and 3 (July 20 issue) had many faults. The stock had to be carried considerable distances, and this could be prevented by placing the equipment in more than one room. The illustrations given at that time, however, were made with the assumption that the entire card room equipment must be located in one room, and that the fine frames must be in a separate room.

Every layout of cotton machinery has some objectionable points, and the proposition condenses itself into determining which of these undesirable features is of

THE LEAST IMPORTANCE.

The writer signed "Mechanic" seems to consider the advantage of having the overseer's duties confined to one room of more importance than we can admit. An overseer in charge of a department as large as the one in question would be quite capable of having subordinates who could be left in charge of any of the rooms while he was called to his other rooms. It would be just as impossible for him to observe all the help in a room over 700 feet long as it would were the help located upon two floors of the same mill. We do not mean to imply that second hands must be hired who will demand excessive wages, for this is not necessary. The overseer who is truly successful will, however, have a second hand quite capable of handling the miscellaneous details or troubles which may unexpectedly arise.

The article in the August 17 issue finds much fault with the layout for the intermediate frames. Doubtless arranging intermediates crosswise of the mill does give a better lighted room. Frames arranged, as shown in Figure 3 (July 20 issue), will obstruct some daylight, and tend to make the middle of the room darker than if the frames were placed across the mill. This is an important point, and should receive careful attention. In building a new mill, however, it is now possible to provide a large window area, so that mills about 100 feet wide would not have trouble with machinery placed as illustrated by Figure 3. It once more comes back to the same point, whether the importance of arranging intermediates crosswise of the mill is greater than any of the other points, which might conflict with this arrangement. Figure 1 is the rear view of a new cotton mill, and illustrates the large window area made possible by modern construction. Figure 2 shows a part of the main Maverick Mill, and also indicates the way large window areas are obtained.

In the third column, page 1227, August 17 issue, the writer who signed himself "Mechanic" states the following: "The chief objection in arranging

THE DRAWING FRAMES

crosswise is that the card delivers

must be carried a greater distance, and when so arranged, can boys must be employed or extra strippers.

"The next objection is the great amount of injury that is sure to result to the can bottoms by sliding the cans over the floor such a distance. This I explained in my article, and pointed out how the nails that protrude from the floor injure the can bottoms."

We do not claim that it is best to always place drawing frames crosswise of the mill. With proper-sized card rooms, placing the drawing frames across the mill does not make it necessary to carry the card slivers great distances. No mill floor can be kept in perfect condition, but there is little excuse for floors with nails protruding so that they would injure the bottom of the sliver cans. Drawing these cans across the floor will, of course, gradually wear them out, but there is no reason why mill floors should not be kept in fairly smooth condition.

Continuing along the same subject, the August 17 article reads as follows: "Regarding mixing the drawing, which is given as an objection for laying the drawing crosswise, let me say that I have run a card room many years, and never experienced such trouble with the drawing frames arranged crosswise. When drawing is mixed, it is due to carelessness on the part of the overseer in not giving the help proper instructions, or not looking after his business."

The writer of this article referred to has not received the idea we wish to bring out in speaking of

MIXING THE DRAWING CANS.

Our contention was that if drawing machinery was arranged across the mill and the number of drawing deliveries in each process was greater than could be placed across the full width of the mill, the drawing should not be arranged in two or more groups. That is, there should not be two sets of first process drawing, two sets of second process, two sets of third process, etc. Arrangements of this kind have been tried, and trouble has arisen from operatives mixing the drawing cans. Drawing cans are frequently mixed when there is no good excuse for the operatives doing this. The article in the August 17 issue states that mixing drawing cans is due to carelessness on the part of the overseer, and in not giving the help proper instructions. This may be true in some instances. It is not so in all. Operatives will sometimes knowingly use wrong cans if they are all placed together. They sometimes do this because it might be slightly easier for them, and they sometimes do it for a reason we have yet been unable to determine. If there is any opportunity for mixing cans, some of the help are liable to do it. The overseer cannot give this his personal attention at all times, neither can the second hand. Drawings should be arranged so that there will be little opportunity for the cans from the respective processes becoming mixed.

There are almost as many

DIFFERENT OPINIONS

concerning the best arrangement for cotton mill machinery as there are cotton mills. Two mill men who are building new mills exactly the same size, and designed for exactly the same kind of work, will generally demand different arrangements for their machinery. Every arrangement has some faults, and the relative importance of these details are what decides the final arrangement. One mill man will consider certain details of utmost importance, while another man will disregard these same questions and show preference to other considerations.

The writer who signs himself "Mechanic" repeatedly states that economy was one of the main considerations. No machinery arrangement can be economical unless it is practical. And in determining whether a layout is practical or not, the entire equipment for each floor must be considered as one unit, as well as a combination of several units.

If the machinery equipment given in the June 22 issue of the American Wool and Cotton Reporter should be placed upon the floors, instead of one,

arrangements similar to those illustrated by Figures 1, 2 and 3 in the July 20 issue would be more satisfactory than they are where the whole of the machinery is on the one floor. For example, with 240 cards placed as illustrated by Figure 1, 31 eight-foot bays will be used. If only half of these cards were placed on the first floor, only 16 eight-foot bays would be necessary, and this would mean that the longest distance any card sliver can must be moved would be

HALF AS GREAT

as with the entire card equipment on one floor. The general method of arranging the other machines could be similar to the layout suggested in our comments published July 20.

If we wish, however, to arrange the intermediate frames crosswise of the mill, as described by the writer signed "Mechanic," we could work out a more satisfactory arrangement by placing the card room machinery on two floors instead of one.

One hundred and twenty 40-inch cards placed like those shown in the June 22 issue of the American Wool and Cotton Reporter would require about 35 12-foot bays; 12-foot bays are used with this layout, so that a pair of speeders can be placed in each bay without interference with the columns. Each card is 10 feet 4 inches long, so that 120 of them arranged in groups of four lengthwise of the mill, would require about 310 feet, exclusive of alley spaces. Allowing 31 three-foot alleys increases this space to 403 feet, so that 35 12-foot bays will give extra space at each end of the mill. In the remaining space we must place 360 deliveries of drawing, 12 slubbers, 24 intermediates, and about 29 or 30 fine frames. The

OBJECTIONABLE FEATURE

of having fine frames in the same room with the intermediates again arises. The fine frames can be placed, as indicated in the article signed "Mechanic," or they can be placed at each end of the mill, and be partially partitioned off from the card room.

The proper natural lighting for weaving rooms has been given much attention of late. A uniform illumination free from exposure to direct rays of the sun has been found advantageous. For this and many other reasons, we fail to see any advantage in placing 2,000 looms in a mill room something like 100 feet wide and nearly 1,600 feet long. By having weave sheds in a one-story building with a saw-tooth roof construction, excellent daylight is obtained. The room can be as wide as desired, as light from the side windows is of little advantage. In fact, side window light for a weave room is sometimes considered a disadvantage, and in some cases weave sheds have been built

WITH NO WINDOWS

at either the sides or ends of the building. The new weave shed for the Maverick Mills in East Boston is a typical illustration of this. Their entire light is received from the saw-tooth roof construction, and the distribution of daylight in this room is excellent. If looms were placed in a long and comparatively narrow mill, no other building could be built near this one, without cutting out considerable light. This would either mean that a tremendous amount of land would be wasted, or the weave room poorly lighted.

The problem of heating a room this length would also be a matter for consideration, and there would seem to be no reason for building such a structure. Although it is possible that filling towers with some kind of conveying systems could be utilized to advantage, they would introduce another expense, and are not desirable unless necessary. It is true that the Stark Mills at Manchester have a cable conveying system across the Merrimac River. This arrangement is a good, practical contrivance, but the fact that the Stark Mills have been obliged to arrange some system for conveying material economically across the Merrimac River is no reason why we should build a mill so designed that an expensive conveying apparatus must be used for carrying filling bobbins from one part of the room to another.

M. and E.

PART II

STUDIES IN MILL MANAGEMENT

I. THE WELL-MANAGED MILL.

While attending a meeting of textile men some time ago, the following question was put to the writer: How is it that one plant on the same class of goods has millions of yards of cloth stored away in their sheds, while in another plant every yard of cloth is sold—they even watch for the cut mark to appear to tear off the loom and ship away at once?

The above question was the sparker to this article—it made me think. The question was quickly answered. Management is the cause for such existing conditions. As I stated before, the question made me think; so I at once visited each plant, and I was soon convinced that I had answered the question right—it is the management.

I will first describe the management of the plant where every yard of cloth is sold months ahead. I was ushered to the cotton shed by the superintendent, and here he explained how the cotton is received at the mill in large quantities, as is usually the case, and where it must necessarily be stored until it is required for use. He said that he really believed that the basis of even yarn in all cotton mills could be laid to a large degree in the arrangement of the bales when stored.

However, he said, before storing any lot, he carefully ascertained whether the quality of the cotton in each bale was equal to the quality of the sample from which it was bought, a practice, he said, that was much neglected in most cotton mills.

COTTON VARIANCE.

All large quantities of cotton vary in quality. This is because most lots of cotton are made up of cottons collected from various plantations, in most cases many miles away from each other, and subject to different climatic conditions, different seed and soil. For this reason he employs a method in arranging the bales as they are stored in the shed, that is practical as well as interesting.

No one is trusted to do this work. As a lot of cotton is weighed, the superintendent himself directs where the bales should be stored, and books every bale stored on a chart; and he also directs how the bales are taken from the shed. He claims that the time spent in this way is well repaid at every process in the mill, and from what I saw going through the plant, he is right.

The cotton shed is about 150 feet long, and when a lot of a hundred or more bales are weighed and sampled, they are placed laterally side by side along the length of the shed, the next row laid on the first row, and so on, until all the bales are stored. When the cotton is to be used, the bales are taken from the middle of the shed to the side.

EFFECT OF MIXING.

It will be seen from the above method that, in every string of bales taken from the cotton shed, one bale only of each lot is taken in a string, and this procludes the possibility of two of the same marking coming together. As the cotton is taken from one side of the shed, the other side is arranged in lateral rows, as explained above. At times when room in the cotton shed is not available, owing to having only one shed to store the cotton, the cotton is left in the yard, and covered with proper canvas. The superintendent said that he knew it was wrong, and not the proper thing to do, but he said he would rather have the cotton stored in the yard, where very little damage results, when left for a short time only, than to store the cotton at once in the shed and break up his system.

I was next ushered to the mixing room, where all mixings are done by hand, which is the only way to mix. The mixing occupies a considerable amount of floor space, which is neces-

sary when mixing by hand or any other way, so as to make all mixings as large as possible. The superintendent said that his carder, when mixing, spread the first bale to cover all the floor space in the mixing bin; the second bale is spread to cover the first bale, and so on, until all the bales are mixed. He said very little waste was made in this mill; but of what little waste they did make, the carder, when mixing, spread a little of it between each layer of cotton.

I was next introduced to the carder, who said that, after mixing the cotton, he always instructed the picker boss to see that the cotton is pulled away in small sections from the top to the bottom of the mixing, in order to obtain portions of each bale. He said that the changing of his picker help often made it necessary to continually see that this was carried out Most of his trouble in the picker room was the watching of the filling of the automatic feed boxes, especially when a new hand was employed, that most of them will allow the boxes to run low, and then refill to the top. Automatic feed boxes should never be allowed to run low, or be filled, nor the cotton pressed to make the box hold more cotton, so that the picker hand can then have a lay-off, so to speak. They should be kept about three-quarters full, and a little cotton added as required, in order to obtain an even lap. This picker room consists of three automatic feeders, four intermediate pickers, and four finisher pickers.

WEIGHT OF LAPS.

The breaker laps are 52½ yards long, weighing 38 pounds; the intermediate laps are 52½ yards long, and weigh 39 pounds; and the finisher laps the same length as the breaker and intermediate picker, the finished lap weighing but 37 pounds. The laps delivered at the finisher picker are very uniform in weight, and are kept as close to the mark as possible.

The carder gave us all a good idea when he said that when he did find a lap too light or too heavy, instead of running through again and taking all the nature out of the cotton, he had such uneven laps, which were few, spread about the room. This he did to proclude the possibility of having the mark run too light or too heavy. It is a great idea. Try it, if only for a week. I found the laps also very clean and free from tufts and bunches, and very little leaf, or seeds were noticed. The writer was not surprised at the cleanliness of the laps, as all the picker machines are on the same floor, and free of the trunking systems, which are nothing else but dirt traps.

I found the cards in good condition and clothed to my liking. The cylinders are covered with 100s wire, also the flats with 110s wire doffer. The sliver at the front of the card weighs about 50 grains per yard, and produces about 800 pounds per week. The mill was built about 16 years ago, and the flats look as good as new, and they are cleaned by a new flat cleaning brush, lately patented for this purpose, that should be in every card room.

There are three processes of drawings with all metallic rolls, and the sliver produced looks as good as any sliver the writer ever saw. The sliver in front of each process weighs about 60 grains per yard, and the front roll makes 410 revolutions per minute.

AT THE SLUBBER.

At the slubber, from this 60-grain sliver, .62 hank roving is made; on the intermediate, 1.60 hank roving, and 4.60 hank roving on the fine speeder to make 28s warp yarn (2 into 1). For the filling, from the 60-grain finished sliver, .70 hank slubber roving is made; 2.00 hank roving on the intermediate, making 6.50 hank roving on the jacks, making 44s filling on the mules.

The work in the spinning was excellent. The overseer in charge said that it was comfort to work for a superintendent that leaves the judgment to the overseer as to the number of turns that should be inserted in the yarn. The spindles revolve about 8,800 revolutions per minute, and the front

roll 108, one-inch American cotton being used. He said that he knew it was better to run a little slower and run all the ends, than to run faster and make a lot of waste; besides he pointed out that it requires but a small number of ends about the room to make up for a frame or more. A nice shaped bobbin is produced from this room, and filled throughout its length, which reduces the cost in the spooling room; for when the spooler box is weighed, you are not weighing wood, as is the case when ring frame bobbins are not properly filled.

ON THE SPOOLERS.

On the spoolers I was shown how all the guides were closed to a certain gauge, so as not to allow any bunches or knots to escape and find their way into the cloth. The warping and slashing was very good, and free from hitchbacks, usually found in this department of most mills. The weaving was excellent; free from any hard sizing which is generally found in most weaving rooms, due to the using of too much gum in the sizing. From the appearance of the cloth, one would be tempted to ask, before going through the mill, if the cloth was not composed of combed yarns.

The superintendent was very courteous, which is generally the case in successful mills, and seemed proud of every machine and its operation throughout the mill. He knew what kinds of roving, yarn and cloth each machine produced. I noticed, as he came to each machine, he would sample the cotton, and feel of the roving and yarn. One could tell he knew his business, and that it was his tireless energy that was making this plant effective. No. 1.

II. THE ILL-MANAGED MILL.

I next visited the mill having millions of yards of cloth on hand, and found conditions deplorable, and a wonder to me that they sold any cloth at all. But this plant enjoys an advantage over other plants, and like a doctor that buries his mistakes, they too bury their mistakes, because a print works is owned by this plant and they cover mistakes by printing their own cloth. I did not approach the superintendent, because I had met him once before, and was received with such discourtesy that I made up my mind I would dodge him, so to speak. I was told by one of the carders that the cotton was brought from the cotton shed in lots and run through together. Even the waste was run through at one time, which made the work equal in the ring spinning room.

I found in the picker room that the cotton was carried from one machine to another by trunks, in order to do away with picker help, thus carrying all leaf and dirt. The laps appeared very dirty, and looked to me very heavy. I could not get the information desired, as every one in charge seemed ashamed to answer my questions. They knew better, they said, than to run the stock through in that way, but were forced to do so.

The cards I found in good condition, but very dirty; besides, the work the card was doing made the card sliver look very bad and dirty, weighing from 65 to 70 grains per yard; and the overseer in charge said that each card produced over 1,000 pounds weekly. The help in the card room seemed to be running a race for life, and each one seemed to me to be overworked and neglectful.

DRAWING.

There were three processes of drawing; some with common leather rolls and some with metallic rolls, the front roll making 530 revolutions per minute, and the finished drawing weighing between 80 and 85 grains per yard, a condition that should never exist in any print cloth mill. The finished drawing sliver appeared lumpy and dirty, and everything seemed to be running in a choking order at each trumpet.

At the slubber, from this 85-grain sliver, 48 hank sliver was made; 1.40 hank roving on the intermediate, and 4.25 on the fine speeders for warp and filling, they having no mules in this plant.

It will be seen from the above that it is impossible to produce good yarn from such a bulky sliver and heavy hank roving.

The American Wool and Cotton Reporter has repeatedly pointed out the mistake of using a heavy, finished drawing sliver and heavy hank roving, and it has explained the reason through its columns.

All good carders know it is detrimental to the making of an even compact roving and yarn, because no one will deny that there is a certain amount of friction on all drawing rolls throughout the mill running a light sliver. So what can be expected when running such a heavy finished drawing sliver and hank roving as is run at this plant.

On the ring frame 28s is supposed to be made, but the writer found it nearer 26s than 28s, produced from all single roving.

BAD SPINNING.

The spinning was very bad, and more ends were down in this spinning room than any five others the writer had the pleasure to visit. An enormous amount of waste must be made weekly from this room. I was told that the spindles made 9,200 revolutions per minute; the front roll 118 revolutions per minute. The overseer told me that it made no difference what kind of stock was running through; that this speed must remain the same at all times.

This is certainly mismanagement, and proves I was right in answering the question beginning this article, because what is the use of having twist gears, if the overseer in charge is not allowed to use them? Why is it necessary to have an overseer at all, because, as the writer understands the duty of a carder and spinner, they can sometimes save the plant thousands of dollars yearly by their knowledge of the cotton, in knowing and understanding the structure of the fibre and its peculiarities, they then know when to take out twist and when to insert twist, saving many pounds of cotton that would otherwise find its way to the waste bag, as is the case at this plant.

I found the bobbins doffed from the ring frame poorly shaped, and not occupying all the length of the traverse.

At the spools I found boxes of bad yarn, due to the carelessness of the management, by allowing machines to run when out of order, producing ragged-edged bobbins. The guides on the spoolers were not set properly, some being opened more than others, all opened too much, that the lumps and knots could be noticed on the warp, slasher and in the cloth.

In the weaving I found, as I did throughout the mill, that quality was a secondary consideration, and if the weaver produced a certain number of cuts which is demanded, his job is safe. On the other hand, if the weaver fails to produce this number, he or she is discharged.

The plant is one of the largest in this country, and consists of several mills. They are all managed alike, and all on the same class of goods—print goods.

I need not describe the cloth produced from this plant, which is, as a rule, of a scratch-up order. The reader can now form his opinion why this plant is unable to sell its cloth in dull times.

The law of compensation is working the management as well as the plant in paying for what it has done.

No. 2.

III. PICKER ROOM EQUIPMENT.

When constructing and arranging a cotton mill for any specific counts, there is one subject which requires special treatment prior to dealing with the constructive details. This is the arrangement of the drafts in the various machines.

The success of a mill depends on the due regard that should be paid to the proper drafting of the machines. This is a duty which falls rather into the governing of administrative than constructive work. However, it is one of the most vital matters in the operation

of the mill. It should always be possible to arrange the series of drafts throughout the mill so that each process can keep up with the other, and also have the best theoretical drafts.

The character of the material employed must be also taken into consideration, because the drafts that are suitable for

SHORT STAPLED COTTON

would not be suitable for long stapled cotton. Then again, the class of yarn which is to be produced must be considered. The range of counts and the production of the machines should be limited by their special construction.

When building a cotton mill, the chief question is the variation of the stock that is liable to occur from one year to another, one kind of stock requiring a longer draft and less twist, while another kind, shorter drafts and more twist per inch.

The cotton crops for the past few years were the cause of so much complaining on the part of most overseers, the cotton being short and requiring short drafts and more twist, and the superintendent, not knowing this, hammered away at his overseers for more production. Shorter drafts and more twist was the only remedy, but most mills have made the mistake that we are now trying to avoid; that is, they could not shorten their drafts and insert more twist, because enough machines were not available. So the work was carried on, and is carried on, at this writing, in many of our cotton mills to-day, which makes the conditions in those mills deplorable.

The picker room should be a part of the main building, and separated by a fireproof wall, and should not be located away from the main building as advised by almost all up-to-date writers, because fire, which occurs very seldom in our cotton mills to-day, is not the only thing to be considered.

The picker room should be a part of the main building, so as to save a lot of unnecessary walking of the operatives, and also the trucking of laps, which calls for extra help.

The

PICKER ROOM

contains the machines through which the cotton passes during its first stages of manufacture, and its equipment requires a great deal of consideration. The first consideration is the planning of the room and the arrangement of the machinery.

Enough machines should be installed for the weight of the lap intended, so as to not overwork the machines, which are of heavy type and, in cases run at a very high rate of speed, besides dealing with stock in a very unclean condition, it is necessary to have a fair speed in this department so as to give this machinery time to open the tufts of cotton and do its work as it should, which is many times repaid in after processes. Again, when the machinery in a picker room is run at its maximum speed, fires occur very frequently, because the swiftly moving parts of the machinery are liable to come in contact with some foreign matter of a hard nature, which in almost every case, causes a fire to occur that will spread throughout the cotton. No. 3.

IV. PICKER ROOM PROCESSES.

An important matter is the process intended in the mill being constructed, whether the mill is intended for coarse, medium, or fine yarns.

For the making of a coarse yarn, for instance 10s or 20s, the following machines should, in most cases, be used: Automatic feeder and breaker picker combined; and finisher picker, the intermediate picker not being used. The reason for this is that the cotton used for a coarse yarn will give better results by not receiving such a severe beating, because this poor grade of cotton requires all the nature it can hold in order to stand the operations of the different processes without being first spoiled in the picker room.

It should be obvious to most carders and mill men that a

POOR GRADE OF COTTON

will not stand a series of beaters as most of the picker rooms of our cotton mills employ. However, when the intermediate picker is not employed, special attention must be given to the grid bars, to have them opened a little more in this system of picking to give the heavy impurities every opportunity to drop through the grid bars.

For medium and fine yarns, in most cases, use the following machines; automatic feeder, opener combined; intermediate breaker and finisher picker.

Buildings should be designed so as to have all the picker room machinery on the same floor. The trunking system gives a lot of trouble in many mills, and although they are called cleaning trunks, the laps that are produced from the cotton carried along a trunk are not, as a rule. as clean as the laps produced from a picker room with machines all on the one floor. The reason is, that when trunks are used to carry the cotton considerable distances to the next machine by means of an air-current that is generated by a fan, there must be curves and bends in the tubes or trunks, which necessitate so strong a current in the tubes or trunks that most all impurities follow the cotton to the lap. Another reason for not using trunks is that in case of fire they give a lot of trouble, especially if made of wood, if not entirely destroyed, the inside is sometimes charred to such an extent as to require a lot of sand-papering in order to make it smooth, and graphite applied freely afterwards. Another important consideration, when equipping a picker room, is to see that the combined area of the fan outlets cut in the floor, leading to the dust flues, does not exceed that of the dust flues themselves, because if it does, the production of a ragged, uneven lap will be the result.

Another consideration is whether to adopt the automatic feed boxes or the bale breakers and automatic mechanical feeders.

All that can be claimed for the latter is that the picker room can be operated with less help, and has

NO OTHER ADVANTAGE

over the automatic feed boxes fed by hand. This new system is all right if the mixings for this system of picking are arranged and blended as in all other systems of picking; that is, to make the mixing as large as possible, and to blend the cotton as much as possible. This new system is much misunderstood, because most mill men conceive the idea, that, because this system is a mechanical feed, it remedies a faulty mixing, such as opening a bale of cotton at each ba'e breaker, and all one bale used in the one machine.

This new system should receive the same care and attention when mixing, as the old system of picking, because, as regards making an even lap, all bales must be blended together in order to produce a strong, even yarn.

No. 4.

V. PICKER SUGGESTIONS.

The type of beaters to be used is another important consideration when equipping a picker room. There is some difference of opinion with regard to the employment of the style of beaters for each machine, whether the blade beater, or the carding beater (which is the latest type of beater), also the number of blades or lags the beaters should consist. The two-bladed beater is more accurately balanced, and is ordinarily about 14 inches in diameter.

The three-bladed or wing beater carrying lags is made 16 to 18 inches in diameter and revolves slower than the two-winged beater.

The respective velocities are 950 revolutions per minute for the three-bladed beater, and 1,350 revolutions per minute for the two-bladed beater. The manufacturer equipping a picker room should see that the two-bladed beater will give a sharper blow to the cotton, and that it also leaves the cotton more quickly.

Besides, it is not so liable to vibrate. Another reason why it is more preferable than the three-bladed beater is that it is lighter and

WILL NOT WEAR

the bearings as soon as the three-bladed beater. When a two-bladed beater is making 1350 revolutions per minute, the blow given to the cotton is sharp and clean. It will be seen that the bearings of the beater shaft can be kept in good condition, and when using the blade type of beaters, should require reversing when dull. They can be readily reversed without removing the bearings.

Another consideration is, in what machine it is best to have the bladed beater, and which machines should have the carding beater.

As we understand the objects of picking machinery, it is the cleaning of the heavy impurities from the cotton and the separating of the cotton into small tufts that are light enough in weight to be influenced by an air-current and form the cotton into a layer, and wind it on a roll in a cylindrical form known as a lap, so as to present it to the card in a uniform sheet, and as free from foreign matter as possible. The best series of beaters that have given the best results to attain the above objects are the following: The first beater acting upon the cotton first should be a three-bladed beater, 18 inches in diameter. The reason for the employment of the three-bladed beater here is because it comes in contact with the largest tufts of cotton, and if the beater at this point is light, it will continually have a tendency to rise, which causes much vibration, sometimes the blades breaking and flying through the bonnet and injuring other machinery. All other beaters should be of the two-bladed type, 14 inches diameter, for reasons previously explained.

We know that the

BLADED BEATER IS BEST

adapted for the opening of the tufts of cotton. The carding beater acting upon large tufts of cotton will break many fibres that are not easily pulled from one another, so that is the reason why the first breaker and intermediate pickers should consist of the bladed type. For the finisher picker we advise the carding beater, so as to obtain a beating and carding action, thus producing a lap that is not equalled in any other system of picking.

A carding beater consists of three wooden logs that are fastened to the arms of the beater, which is mounted on the beater shaft. Steel pins that are arranged spirally project from the logs. The pins that first come in contact with the cotton are shorter than the others following.

It can be seen with this arrangement that the pins penetrate and break up the cotton. Entering gradually, the strain incident to the operation upon the fringe of cotton is almost equally distributed among the pins, causing the beater to combine a carding and beating action, thus removing a lot of work from the card, which it otherwise would be called upon to do.

Another very important consideration is the best kind of grid bars to adopt, through which the beater knocks the impurities, because they are important agents in the cleaning of the cotton. There are many kinds of grid bars, but the best kind is the pin type, which consists of sharpened pins, arranged in a bar with their top edges rounded off. Before they were rounded off, the top edges of the bars did not give the heavy impurities the same chance to escape as the latest kind do.

The grid bars explained above are, no doubt, the best, because they form a surface only to hold the fibres in the field of the air-current, and, of course, the heavy impurities, such as seed, leaf, and other small particles, fall through the pins and bars.

Another consideration, when equipping a picker room, that will save a lot of waste, is to adopt a

HOLLOW LAP ROLL,

instead of the solid type. When the solid lap roll is used, it is necessary at the next succeeding process that a rod be pushed through the opening left by the solid lap roll withdrawn from the lap. In many cases, the operatives

are unable to guide this rod in the same channel as was occupied by the solid lap roll, and consequently, the rod is forced through, thus making an enormous amount of waste. This waste-making is all overcome by using the hollow lap roll. A rod having a large flat head, larger than that of the lap roll is inserted while the lap is still on the roll, and thus is in position when the roll is withdrawn from the lap. No. 5.

VI. LAP LENGTHS.

The length of the lap intended should also be considered. This is a mistake made in most all mills, instead of having a long and light lap, they have a heavy, short lap. It must be understood that the tufts of cotton must be a great deal lighter for the production of a light lap than for a heavy one, and that the more the tufts of cotton are opened the more impurity is taken out. This is also true with the card—the less fibres the laps contain to the inch, the better chance the licker-in has to clean the cotton. This subject will be taken up later.

So if a light lap is best, which no doubt it is, then in order not to lose any production, the proper gears to quicken the feed, and also to make a longer lap, should be put on the machine before it leaves the builder. When equiping a picker room, very little attention should be paid to the drafts, because, practically speaking, there is no draft to a picker. It is the blows to the inch that are the so-called draft, and should be considered, for it is important for many mills at the present time not to beat the cotton too much. Beaters, as a rule,

SHOULD NOT STRIKE

the cotton more than about 55 blows, nor less than 25 blows per inch of cotton fed.

Another important consideration is to see, before the machines are started, that the space around the cages is properly covered with leather. The leather should be cut in cylindrical shape, so as to fit the end of the top and bottom cages. This is neglected very often in starting a picker room, and to-day, there are cases where the mills were built from 16 to 20 years ago, and this matter is neglected, so that cotton in large tufts can be seen coming from the dust room outlet, and those in charge will tell you that it is impossible to stop it. This good cotton escaping from the dust room outlet is a neglect that is very expensive, especially at the present time, when the price of cotton is so high, and it is surprising to us how many mills will allow these conditions to exist and continue, when a few pieces of leather, cut properly and placed in the space around the screens, will save many dollars to any plant where such conditions exist.

Too much consideration cannot be given to purchasing the picking machinery, consisting of dampers, that can be regulated on the side as well as in the middle. The making of a good lap is an important point. If this matter of purchasing the machines, where the air-current can be regulated on the side as well as in the middle is neglected, there will always be trouble in the working of a perfectly cylindrical lap, that will feel as firm at one point as at another—as it should do.

When the air-current is stronger on one side than on the other, the side having the weaker current is usually soft, and if the dampers cannot be regulated on the sides, it is a difficult matter sometimes to overcome. This matter will be treated more fully in the operations of the picker room. No. 6.

VII. PICKER ROOM MIXING.

After a picker room has been equipped and ready to be operated, the first thing to do is to run all machines without any stock passing through, so as to smooth all beaters and fan bearings. Next, see that the beaters and fans are properly balanced, as this cannot very well be done when the stock is passing through, because the action of the beater upon the stock causes a little vibration of the beater at all times. Many hours' work can be saved after days of operation by having beaters and fans properly balanced.

It does not require skilled help to operate a picker room, (although the best help should be employed), and for this reason many mills consider the picker room too unimportant, and this is where a great mistake is made, because any neglect in this department will be felt throughout the mill. In mixing, try and mix cotton of one length, if possible, because a mixture of different varieties, which are not equal in length, it should be prejudicial to good and economical work. It is absolutely necessary, if full economy is to be obtained, that

CARE SHOULD BE TAKEN

to mix only such staples as work well together. Even when the cotton is equal in length, the cotton should be blended as much as possible, by mixing only one bale in every ten of a certain mark if possible, because most lots of cotton are made up of cottons collected from various plantations, which are probably some distance from each other, and subject to different climatic conditions, different methods of cultivation, different seed and soil and some bales compressed harder than others, in some cases compressed so hard as to injure the staple. When mixing, after each bale is opened, a sample should be obtained from each bale, and pulled and compared with the next bale, and so on, and if any staple is found that is longer than the average, or some found shorter than the average, these bales should be kept one side, and run through separately. No. 7.

VIII. MIXING AND FEEDING.

When mixing, the cotton should be pulled in small tufts, as small as possible, and mixed in large quantities, the larger the better. It should stand open at least three days, and more, if possible. The larger the mixing, the easier it is to keep the work regular for a considerable length of time, for the reason that no two mixings are alike. This is due not only to

THE VARIATION

found in different bales of the same kind, but also to atmospheric changes that affect the cotton, especially in regard to moisture. Another reason for having large mixings, is to give the cotton from compressed bales an opportunity to expand. When a hundred or more bales of cotton are to be mixed they should be opened as soon as possible so as to give the cotton this opportunity to expand. The mixings should occupy a large amount of floor space, and the first bale mixed should, if possible, cover this space; then a little waste spread over this bale, the second bale, and a little waste, and so on, until all the bales are mixed. When the cotton is pulled from the mixing, it should be pulled in sections from top to bottom of the mixing, so as to obtain a portion of every bale mixed.

Besides choosing cotton of practically equal staple, mix strong, harsh fibres with others that are a little weaker and softer for the warp yarn, but only soft, pliable ones for the filling.

The cut roving waste received in the picker room from the ring spinning and mule room, should be spread on the floor of the picker room and scrutinized, because the help sometimes

CARRY MATCHES

in the same pockets with the cut waste, and in emptying their pockets in the waste box, they forget the matches. In this manner, they find their way to the picker room, and are the cause of many fires. Besides this, cut roving waste contains matter of a hard nature, such as guide wires, rings, ring holders, etc. When the waste has been looked over, and freed from all such matter, it should be spread on the feed apron, and run through the first breaker; then taken to some available place until mixing time, when it should be mixed as described above.

When roving waste is being run through, a few pails of water should be placed near the machine, so that if a fire should occur from this waste, time would be saved, and what might be a serious fire, quickly extinguished.

Persons having charge and operating a picker room should give this waste question much consideration,

for the cause of split laps can generally be laid to the mixing of too much waste at one time.

The automatic feed box should be watched at all times, and should be fed regularly and kept about three-quarters full. It should never be allowed

TO RUN LOW,

and then be filled to the top—some operatives even pressing the cotton so as to make more free time for themselves. The lattice feed apron should be examined often, to see that no slipping takes place, because when the lattice apron stops, which is often the case, the spiked lifting apron takes up the cotton irregularly, making uneven places in the lap. The lattice feed-apron should be kept tight, because any intermittent action at this point has the same effect as not filling the automatic boxes regularly. The lifting apron should travel about 72 feet per minute, and when it is necessary to change the amount of feed, do not change the speed of the apron, nor move the comb or spike roll nearer to or farther away from the lifting apron, but speed up the entire feed. This can be best done by putting a larger pulley on the beater shaft, driving all parts of the feed connections. The reason why it is better to speed up the entire feed, is that when the lifting apron is speeded, or the comb or spike roll is set nearer or farther away from the lifting apron, it makes the lap correspondingly heavier or lighter, but by speeding up the entire feed, the same results are obtained, and it does not affect the weight of the lap. Of course, this can be overdone; but if the blows to the inch of cotton delivered are taken into consideration, and the beaters do not strike the cotton more than sixty blows to the inch, and not less than 30 blows, no harm will result.

No. 8.

IX. SETTING THE PICKER.

In setting for an 11-ounce lap, composed of one-inch American cotton, set the beater blade from the surface of the feed roll, so as to pass a gauge three-sixteenths to five-sixteenths of an inch in thickness; set away for longer stock, at the same time, set to the stripping plate as close as possible. This should be done before setting the feed rolls to the beater, because you can move the feed rolls, while the stripping plate is always stationary. Set the stripping plate as close as possible, say one-eighth of an inch, so as to prevent any draft at this point, which may take some of the fibres around the beater a second time, instead of following the air current to the cages.

Set the grid bars on the breaker nearest the feed rolls one-half inch from the beater, increasing a little at each lower bar, so that the last bar will be three-quarters of an inch from the beater. Setting the grid bars is very important, although most persons in charge of these settings give the matter very little consideration It should be remembered that if set too close to the beater, the fibres will be injured; if set too far apart, or too far from the beater, the waste will be excessive. Besides

INJURING THE FIBRES,

a too close setting will cause much dirt, leaves and seeds to follow the air current, and consequently, remain in the lap. Sometimes, when the bars are set closer together, a space is left between the feed rolls and the first top bar. In this case, an extra bar should be kept on hand and placed in this space when the bars are set closer, in order to receive any benefit from the closing of the bars.

A three-bladed beater, 18 inches in diameter, should revolve 900 to 1,000 revolutions per minute. A two-bladed beater, 16 inches in diameter, 1,150 to 1,250; and a two-bladed beater, 14 inches in diameter, 1,250 to 1,350 revolutions per minute. The fans in the breaker should revolve about 1,000 revolutions per minute, and the fans in the intermediate and finisher picker about 900 revolutions per minute.

In order that a beater shall open the cotton in small tufts, the

blades must be kept sharp, (not to a knife edge), because when a beater is dull, the blade fails to take the proper amount of cotton from the feed rolls at each revolution of the beater, so there is always too much cotton between the blade and the feed rolls. This has a tendency to push the beater blade away from the feed rolls, which makes a noise like a saw-mill, and causes the beater to vibrate. When a beater blade is dull, it should be reversed, and when both sides are dull, the beater should be taken out and the blade planed by one who knows how. Care should be taken that the beater is

PROPERLY BALANCED

before replacing, because it often occurs that too much is planed off one blade, thus throwing the beater out of balance.

The air current that draws the cotton to the cages should be regulated to draw the cotton to them in such proportions that the upper cage will receive an amount slightly in excess of that which the bottom one receives. The reason for this is that if the sheet delivered in front of the machine contained or was composed of two layers of practically the same thickness, it would be able to split when run through at the card lap.

The object of the air current is to play through the newly opened cotton, and carry away the dust and other foreign substances, which adhere to it, and deposit only the cotton onto the cages. If the beater is revolving too fast, the draft of the fan will be destroyed to a certain extent, and good fibres will escape through the bars. On the other hand, if the beater is running too slowly, the draught of the fan becomes so strong that it takes with it all the heavier impurities, which results in a dirty lap.

If the air current is stronger on one side than on the other, the side having the weaker current is usually soft. This trouble at times is very

HARD TO LOCATE,

but if the picker has dampers so as to be able to regulate the air current on each side as they should have, this trouble is soon remedied. The velocity of the air current is also responsible for the amount of waste removed. If the current is too strong, it prevents good cotton from being stricken through the bars, and prevents all the dirt from being removed, since the current is strong enough to carry it forward onto the cages. If the current is so weak that the dirt drops readily, good cotton may also drop with it, thus making excessive waste. Fans running between 900 and 1,000 revolutions per minute, will create a medium air current that will allow the removal of the greatest amount of dirt with the least amount of cotton. It should be remembered that split laps are caused by mixing too much waste at one time; and also by not regulating the air current, so that the upper cage will receive an amount slightly in excess of that which the bottom one receives. It is surprising how some mills have split laps, and instead of locating the trouble, they will buy split lap preventers. There is no need of such a device to be attached to a picker, in order to prevent split laps. It is all done in the air-current, as explained above.

No. 9.

X. TROUBLES AND REMEDIES.

The setting of the grid bars also aids in removing the greatest amount of dirt, with the least amount of cotton, and the matter of keeping all the parts clean cannot receive too much attention. Sometimes it is necessary, in order to avoid an excessive amount of air entering through the grid bars and preventing the removal of the dirt, to admit air through the ends of the beater cover, or through the casing that extends over the passage between the beater and the cages.

As was pointed out in the equipment of a picker room, the picker, on leaving the shop, should be equipped with a damper and openings.

The laps delivered should be as near a uniform weight as possible. Each lap from the finisher should be weighed, and if a variation is found, a daily

record of such variations should be kept. The laps that weigh on the same standard should be put in a certain place, and the strippers allowed to take them at all times. The lighter and heavier laps should be kept one side and distributed among the cards, so as to avoid the possibility of getting the work too light or too heavy. Running laps over again injures the stock, by taking the nature out of the cotton, which makes the stock fluffy, like waste. Laps that have a variation of one pound in either direction, should be

KEPT IN LOTS

for distribution; but, of course, if they are found weighing outside this range, they should be put back and run over again. But it is so seldom that a lap does vary this much, that the amount of cotton injured by so doing would be very little.

Uneven laps in many picker rooms are caused primarily by neglecting the weighing of the laps; besides, the fault may be at several places. The automatic feeder may be feeding unevenly, as was pointed out; the cone belt may be too tight, thus preventing the belt shipper from acting quickly; or the cone belt may be too slack, causing it to slip on the cones. The evener, either on the intermediate or finisher picker, may be out of order, or some of the stock may be wound around the feed rolls, thus occupying a certain space that should be occupied by newly fed cotton, which causes a light lap.

Below is given a table showing for what numbers of yarn certain weights of lap are generally used, and we wish to point out to the reader that the lighter the lap the smaller the tufts have to be; the smaller the tufts, the more cotton is opened, and the more the cotton is opened, the greater

AMOUNT OF DIRT

is removed from the stock:

No. of yarn.	Weight of lap per yard, ounces.
10s to 20s	12.5
20s to 30s	12.
30s to 40s	11.
40s to 50s	10.5
50s to 60s	10.
60s to 70s	9.75
70s to 80s	9.
80s to 90s	9.
90s to 100s	8.5
100s to 120s	8.5
120s to 150s	8.

Fire is likely to occur in a picker room, on account of the high speeds at which the beater and fan are made to revolve. For this reason, pickers should be kept well cleaned and oiled. All oil holes, wherever possible, should be covered. When a fire occurs, the first thing to do is to stop the feed at once; then stop all the machines. See that the dust room is free from fire before the machines are started again; also see that the solder of the cages has not melted.

It must be understood that the above speeds and settings are not absolute, and they must be determined by practical experiments. No. 10.

XI. PICKER-ROOM CALCULATIONS.

All managers of mills naturally have a curiosity to know something about the different methods employed in the different processes throughout their plant.

These articles running in the American Wool and Cotton Reporter are for the manufacturer, treasurer, superintendent, overseers, second hands and operatives as well. Our aim is to give practical, every-day methods, which will be found mainly original.

We have explained the equipment of a picker-room, also its operation. It is now necessary to give a few calculations before passing to the card. Many books have been written about drafts, so we will give only the calculations required to operate a picker-room, which is all that is necessary. The

FIRST CALCULATION

necessary for a picker-room is to find the length of the lap. This is done by multiplying the diameter of the bottom calender roll by the change gear and knock-off gear and by 3.1416. Divide this by the worm (which counts one when single, and two when double), and by the bevel gear on the lower end of the angle shaft and by 36 inches.

The above is the Kitson measuring motion calculation, and needs very little explantaion to any person acquainted with a picker-room.

A worm keyed on the shaft of the bottom calender roll meshes with the change gear, the change gear being on the upper end of the angle shaft. The bottom bevel gears receive motion from the change gear and shaft. The bevel gear on the bottom of the angle shaft meshes with another bevel gear carrying a dog having a projection cast, so as to engage and knock off a lever to stop the feed at every revolution of this so-called knock-off gear. The reader should have no trouble in finding the length of the lap if he will keep in mind that increasing the size of the change gear makes a longer lap. So, the first thing to do before starting the picker is to find the number of each gear, except the change, which, of course, we are not supposed to know

WHEN STARTING UP

new machines. For the convenience of calculation, we will assume in this case that the diameter of the bottom calender roll is seven inches, the worm, single which counts one, the gear on the lower end of the angle shaft 21 teeth, and the knock-off gear, 30 teeth. First, find the constant which is obtained by leaving the change gear out, and can be used to advantage forever after.

$$\frac{30\text{x}(1)\text{x}7\text{x}3.1416}{21\text{x}1\text{x}36} = .8726 \text{ constant.}$$

Now, suppose you wanted to make a lap 52.5 yards long, all you would have to do is to divide the constant into the length of lap desired, which will give you the gear. (52.5 divided by .8726 equals 60 gear.) Or, if you want to know how many yards a certain gear will produce, use the following example: .8726 times 60 equals 52.35 yards. Having found the length of the lap, it is then always an easy matter to find the weight of one yard of the lap in ounces. Suppose the lap at the breaker picker weighs 39 pounds, we have the following calculation to find the weight of one yard of the lap in ounces. 39 times 16 equals 624 divided by 52.5 equals 11.88 ounces to the yard. The above simple example is the only one necessary to obtain the weight of the lap per yard to give the proper draft desired on the card. To draft a picker from the feed-roll to the calender rolls is all

RIGHT IN THEORY,

but not in practice, besides much time is saved in the above method. As was stated before, the draft of a picker should not be taken into consideration, but the blows to the inch instead.

To find the blows struck to the inch on the cotton feed, multiply the diameter of the feed-roll by the revolutions of the feed-roll per minute, and by 3.1416, and divide this into the number of blades and revolutions per minute of the beater.

EXAMPLE.

Diameter feed roll.. ....2.5 inches
Revolutions per minute feed roll..................9
Number of blades on the beater...................2
Revolution of beater per minute..............1,300

$$\frac{1300\text{x}2}{2.5\text{x}9\text{x}3.146} = 36.78 \text{ blows.}$$

The above number of blows to the inch will be found to be the best for one inch American cotton, which we recommend. In connection with the consideration of the blows to the inch, the distance from which the lap is held and that with which it is struck is of importance. We

have given the distance elsewhere, but there are times with poor cotton going through, that by giving this distance due consideration, the running of the work throughout the mill is improved considerably. If the distance between these points is too great, the blow of the beater first bends down the sheet of lap presented to the blow of

THE BEATER BLADES

and then strikes off the fibres. It should be obvious to all mill men that unless the cotton is removed regularly in this way there exists a danger in the second blow of some bruising of the material, which makes the lap as it leaves the finisher picker look fluffy, and not in a compact form, as it should be.

Another important consideration in calculating this distance, is that the beater shaft and bearings will wear. That in time will affect this distance to such an extent that besides injuring the stock, the beater blades will strike the stripping plate, thus injuring it, and also the blades on the beater. No. 11.

XII. PICKER-ROOM MANAGEMENT.

In the management of a picker-room the chief aim, as was pointed out before, should be to run as light a sheet of lap as possible, and to run the picker-room every hour in the week, instead of running a heavy lap, and shutting down this department on Friday night of each week, as is the custom with many mills. We have pointed out before that in order to make a light lap, the tufts from the automatic feed-boxes throughout the picker-room are made smaller, and it is obvious that the smaller the tufts, the more foreign matter is extracted from the stock. Theory is all right, but it

HAS ITS LIMITATIONS.

For instance, the writer was approached not long ago by an ambitious young man who had in mind making a longer lap on the finisher picker. He had a good idea, which was to make the lap run over two hours on the card, so that there would not be so many lap ends run through, which in almost all cases punctures the screens in the card.

The superintendent objected to making a longer lap, pointing out to this young carder that the larger and longer the lap was made, the more friction was caused from the fluted calender lap-rolls. In other words, the larger the lap was made in diameter or in length, the fluted calender rolls also increased the length on account of the outside of the lap not being firm when large. The writer is willing to admit that a little friction does exis at this point, but the amount is too small to be taken into consideration, and is so misunderstood by many who have the idea of making a longer lap, that they accept the theoretical part of the question with the result that the card suffers. A cone belt that is not cut with square ends at the piecing and running out of line, will do a lot more injury in this respect than the friction caused by the flutes on the large calender rolls. When a cone belt is running

OUT OF LINE

at the piecing, it is continually striking the belt shipper, and prevents the shipper from acting quickly and shifting the cone belt to another position on the cones as it should, causing a light and heavy place throughout the lap.

Let us reason it out and see the harm this defect will do. If the belt shipper does not act quickly, surely one yard of lap will pass beyond the action of the evener motion. For the convenience of calculation, we will assume that there is a draft of 100 on the card; so if one yard of lap is either light or heavy, we have the following enormous length of defective sliver in front of the card: 36 times 100 equals 3,600 inches of defective sliver that will be increased in length at every drawing process. It must be remembered in the above case that such a condition would exist throughout the lap. The above is only one of the hundreds of causes we wish to point out that are responsible for much

weak yarn, on account of its unevenness.

Another point to be considered in the the management of the picker-room, is the fact that the eveners will not remedy very uneven laps from the breaker picker. There is one chief criticism that may be made, which is, that the evener motion does not act on the stock passing through it until at least a part of the

UNEVEN WORK

it is supposed to correct has passed beyond its action. So it can be seen that in all systems of picking, using eveners, the minute details pointed out in this article must be given the closest attention possible for the production of an even compact lap, and not too much dependence placed on the eveners, as is generally the case in picker-rooms.

Any person having charge of a picker-room should always keep this firmly in mind, that all irregularities in the lap are exactly reproduced in the card-sliver, and all dirt not removed must be removed by the card. So let it be your aim to remove all unnecessary work from the card, because it is absolutely imperative for the complete success of carding to have good laps to start with. No. 12.

XIII. CARDING CALCULATIONS.

When cotton is presented to the action of the card, it has been, as stated, cleaned and opened, although it has not been thoroughly freed from all impurities, and the lap of cotton, as it leaves the picker, consists of cotton fibres crossed in all directions, together with a small amount of foreign matter of too light a nature to be removed by the action of the beaters or to drop through the grid bars of the pickers. It is carried forward by the air current, together with the cotton into the lap. The proportion of the latter, however, is not large, and with the late improvements in picking, is yearly growing less. Carding is the

MOST IMPORTANT PROCESS

in cotton yarn preparation, and is the basis for strong or weak yarn.

The card has three objects: The first is to disentangle the fibres of cotton; the second, the removal of all impurities too light to be removed by the picking machines, and the third, the reduction of the weight per yard of the material, and forming the sheet of lap into a sliver, which is accomplished by the draft on the card. Almost every mill man knows what a draft is, when they are called on to explain it, they are unable to do it clearly, and the writer deems it necessary to explain it here.

A draft may be expressed in several ways. Draft is the surface speed of the front of the delivering roll divided by the surface speed of the back roll, or the number of inches delivered in a certain time divided by the number of inches fed.

Draft is equal to the hank coming out divided by the hank going in.

Draft is equal to the weight per yard going in divided by the weight per yard coming out.

In all of these methods, if close figuring is desired, any waste that is taken out in this process must be allowed for, especially on the card. To save time, and also to make as few mistakes as possible, it is advisable to have all

CALCULATIONS

as simple and short as possible, which is our aim in this work. In order to accomplish this, constants are used for drafts and also production. When changes are made on machines, certain gears and pulleys are used, and the changes made with them.

Then, in making calculations by leaving out the change pulley or gear we get a constant which represents all of the calculations, except the change gear or pulley. Then, by dividing or multiplying the constant by the change gear or pulley, we get the desired answer. When the constant is divided, it is called a constant dividend, but when multiplied it is called a contstant factor. We give below the draft constant calculation of the Saco & Pettee card, and for the benefit of the learner who is unable to draft a card from the lap or feed roll

to the coiler, we will give an example showing that it is not necessary.

As stated above,

TO FIND CONSTANT,

leave out the change gear, and call it one: Feed roll, bevel gear, 120 teeth; gear on side shaft, doffer end, 40 teeth; doffer gear, 214 teeth; gear on card calender roll, 27 teeth; diameter feed-roll, 2.25 inches; change gear counted as one tooth; gear on doffer pulley, 45 teeth; card calender, roll gear, 21 teeth; gear on coiler upright shaft, 17 teeth; diameter coiler calender roll, 2 inches. Following is an example:

$$\frac{2 \times 120 \times 40 \times 214 \times 27}{2.25 \times 1 \times 45 \times 21 \times 17} = 1534.53 \text{ constant.}$$

To find the draft gear required, divide the draft desired into constant, and the quotient will be the draft gear. To find what draft a certain gear will give, divide the draft gear into the constant and the quotient will be the draft.

EXAMPLE.

1534.53 divided by 20 draft gear equals 76.72 plus draft

As stated before, our work is to eliminate this unnecessary drafting by using the following method: Suppose in starting a new mill, you wish to produce a card sliver about 55 grains per yard, and the lap leaving the picker-room weighs 11 ounces per yard; the first thing to do is to reduce the 11 ounces to grains. There are 437.5 grains in one ounce, so we have 437.5 times 11 equals 4,812.5 grains. Divide this total number of grains by the weight of the sliver desired. (4,812.5 divided by 55 equals 87.) From this quotient take out 5 per cent allowed for the foreign matter extracted from the cotton. (87 times .95 equals 82.65, draft of card). Now take your machine book, and it will tell you what gear to put on the card for the draft above. If the

DRAFT OF THE CARD

is known, divide it into the total number of grains, and the quotient multiplied by .95 will be the weight of the card sliver. For a print cloth mill, try to have the card sliver about 55 grains per yard to make 28s warp yarn, and a 50 grain sliver for a 42s filling yarn.

Much more benefit will be obtained from a light lap, even if the doffer has to be speeded to make up the necessary production. Of course, if a large number of cards are available to give the required production, it is much better to run the doffer slow, also, but what we wish to point out, is that the speed should be sacrificed, instead of the draft in a print cloth mill running one inch American cotton. No. 13.

NO. XIV. CARD EQUIPMENT.

We will now explain how to equip a card, and also explain every action of all parts upon the cotton while passing through, giving the reasons why a light lap is much preferable to a heavy one. The first thing we would like to have the reader know is that the fibres make a complete somersault at each process, and the end of the fibre presented to the licker-in is the last to leave the card. This should be studied in order to get a good knowledge of the carding process.

Card equipment should receive a few important considerations, which are as follows: (1) In regard to the feed plate or feed rolls. (2) To have the licker-in covered with ordinary wire fillet or saw-tooth. (3) To have the cylinder flats and doffer covered with suitable fillet for heavy or light yarns.

Some mill men prefer having

TWO FEED-ROLLS

instead of having one feed-roll and feed-plate. We recommend the feed-roll and feed-plate, because one-fourth of the diameter of the feed-roll is covered with loose cotton before it comes under the action of the licker-in teeth. Another disadvantage is that the fringe of cotton does not hang downward, as with the feed-plate, which prevents the licker-in having the same opportunity to operate on the fringe. Another disadvantage is that the bearings of the feed-rolls will wear and disturb the setting. The bearings of the feed-rolls are more liable to be displaced than the feed-plate.

As regards covering the licker-in, it should be covered with a saw-tooth fillet, because the saw-tooth precludes the possibility of the cotton being taken around a second time, which injures the fibres.

As regards the covering of cylinders, doffer and flats, for coarse work, the twilled fillet is preferred on account of the stronger edges, but for medium and fine work, the card should be covered with rib-set fillet.

For coarse work, cover the cylinder with 80's wire, the flats with 90's wire, and the doffer with 90's wire. For medium work, cover the cylinder with 100's wire, the flats with 110's and the doffer with 110's. For very fine work, cover the cylinder with 120's wire, the flats with 130's, and the doffer with 140's wire; the reason for this will be explained later. No. 14.

XV. CARDING ACTION.

We have stated that the fibres make a complete somersault at each process. We say this so that more care will be given to the combing of the fibres if this statement is considered. Some writers tell us that in order to have a

PROPER COMBING ACTION

at every point of the card the parts must be properly set and the wire well sharpened, so as to engage the end of the fibres presented to the card cylinder, and carry them around and under the flats in order to receive a combined action. We read the above statement many times, and if the same is true, as many believe, then the end of the fibres held by the cylinder wire points do not receive the same combing as the free end of the fibres that are carried under each flat, because if the above statement is accepted, the free ends of the fibres are drawn through the wires of the flats, while the other ends are still held by the cylinder wire points. Now let us reason together and see if the above is true. If the wire points on the flats are just as sharp as the wire points of the wire on the cylinder, as they should be, and at the same time more numerous to the square inch, the points of the wire on the flats have the same if not a better opportunity of holding the loose ends of the fibres at times.

After many years of study upon this point, the writer has come to the conclusion that there is a dual operation always going on, namely, the cylinder wire points holding the fibres for a certain length of time, and the points of the wire on the flats holding the fibres a certain length of time.

It may be asked, if the above is true, how is it so many fibres are taken to the doffer? The answer is that the cylinder revolving at such a high rate of speed

CREATES A DRAFT

that causes a sucking action to always exist between the flats and cylinder, which carries the majority of the fibres forward; besides the surface velocity of the cylinder is so great that it has a better opportunity of taking the fibres by the flats—the flats traveling at such a slow rate of speed.

If the reader is a carder or mill man, he should see the importance of keeping the wire on the flats as sharp as the cylinder and doffer wire, and that the cylinder wire does not hold all the fibres or a part of the fibres without loosening their hold one or more times. Again it should be seen that a dual at this point is necessary in order to give both ends of the fibres a proper combing. We know that many readers will not accept the above statement, but if they will stop and think that each flat has the same opportunity to hold the fibres (especially if the flats are set to 3-1,000, as is done in some New Bedford mills) as the doffer, which is supposed to remove all the long fibres, he may change his mind.

Here is a point for your fine goods mill men to consider, when you set your flats closer than the doffer.

The question is, how many good fibres are taken by the doffer and taken around a second time? I regret to say that if this matter was taken into consideration, some of the men in these fine goods mills would

CHANGE THEIR SETTINGS.

The idea we wish to convey by the above explanation of the importance

of giving both ends of the fibres the same combing, is that the end of the fibres held by the wire points on the cylinder are the ends of fibres that leave the card last. The grinder and overseer should keep this fact well in mind. When the sliver is put up at the back of the drawing frame, the free ends of the fibres not held by the cylinder wire are the first to be presented to the drawing rolls. So it can be seen that the sliver does not follow a straight road as some believe, but instead, as stated before, makes a complete somersault at each process. In order to have both ends of the fibres straightened so that the drawing rolls can act upon most of the fibres presented, it is necessary to give the same attention to the flats, and keep them as sharp as the cylinder and doffer, so as to create a dual between the wire points on the cylinder and flats, in holding the fibres in intervals, as explained above. No. 15.

XVI. CONDITION OF LAP.

The most important consideration in the carding process, as we have stated before, is the condition of the lap. We have given an example, showing that when the lap is uneven for only a short length that this length is increased at every drawing process. Again, we have pointed out that the only work the card should be called on to do is the removal of short fibres and

IMPURITIES,

which is impossible to remove in the present picking system, without breaking the fibres.

If a light place in the lap is presented to the combing action of the licker-in, and then a heavy place, instead of feeding the licker-in teeth at a steady rate, fewer fibres will be conveyed to the cylinder when the light place of the lap is being fed in, and a great deal more of fibre is presented to the licker-in teeth when the place in the lap is heavy.

It is obvious that during a certain number of times the cylinder is revolving (which is a great number while one inch of lap is delivered) the number of fibres presented to the cylinder varies according to the thickness of the sheet of lap. Granting that the cylinder is charged with stock and that this will help somewhat the weight of the sliver from being too light, it should be seen that if the first argument holds good when the heavy part of the lap is fed the cylinder is over-charged.

Some writers claim that, if the variations in the lap were great and prolonged, this point could be easily demonstrated. They claim that the difference in thickness of the lap is at the present day not great, and the thin and thick places are not of great length, which fact makes it difficult to trace their effects.

I am sorry to say that if all carders would care to admit it, they would tell us that the variation at the present time is great.

WEIGH YOUR CARD SLIVER

at every interval of five minutes, and a surprise is in store for the skeptic.

The writer has seen a variation of eleven grains to the yard in many mills throughout the country—the majority of the mills varying from three to seven grains.

The only way to reduce this variation is, as we have pointed out, by not depending so much on the eveners. Only eternal vigilance and the watching of the filling of the automatic feed boxes will produce an even lap, because in this way the sheet presented to the intermediate picker is made more even, and what little variation exists the evener will help. It must be understood that for the reason previously explained, it will not correct it altogether. No. 16.

XVII. SETTING FEED PLATE.

In setting the feed plate, the first thing to do is to arrange the lap guide so that the sheet of lap will not spread beyond the action of the teeth of the cylinder and fall between the cylinder and casing. If this is not considered excess power will be used in revolving the cylinder, and there will be danger of fire starting at the heated bearings. There are more arguments about the

setting of the feed plate among carders and writers than of any other part of the card, and we will now thresh out this matter, we think, to the satisfaction of those who are willing to reason.

In the first place, to understand the following explanation it is necessary for the reader to imagine that the sheet is first struck down by the licker-in teeth, and by the licker-in teeth playing through this newly opened cotton, a sheet of fibres hanging downward is formed. The question is how to set the feed plate to receive

THE FULL ADVANTAGE

without injuring the fibres.

Some carders and writers advocate setting the feed plate as close as possible to 5-1,000, others go so far as to say that it is impossible to set the feed plate too close, so long as it does not come in contact with the licker-in teeth. This is wrong, both in practice and theory, and is so misunderstood that we explain it here.

If the licker-in is set to almost touch, it will be found that there will be too much work in such a small space (although the writer is willing to admit that no injury to the fibres will occur if the proper nose plate is used according to the length of staple) and work makes heat. When the card is stopped the wax in the cotton is softened by the heat caused by the nose plate resting on its surface. This makes the nose of the feed plate stick and cotton accumulates until we have what is termed a caked nose feed plate. The mill men in the state of Maine should take notice, for much of this plate caking was experienced in that state a short time ago, through this close setting of the feed plate. No doubt many overseers and writers will take exception with the writer for the above statement, but let me ask why it is that a dull licker-in will cause the nose of the feed plate to cake? It is the

SAME EXPLANATION

over again, the licker-in teeth being dull do not remove the amount of stock at every revolution of the licker-in, so we have the same trouble only in a different way; that is, in one way the working space is made small by setting the feed plate too close, while in the other way the working space is made small by too much cotton remaining between the feed plate and licker-in at every revolution of the latter. When the points of the licker-in wire strike the projecting end of the lap they pass through it at such velocity that the heavy adherent impurities are struck down and partially removed.

The number of teeth that pass the nose of the feed plate while one inch of cotton is delivered is about 2,000,000. So it can be seen that what we have pointed out elsewhere about the running of a light lap is of much benefit to the work throughout the mill, because it can be seen that there are fewer fibres to be acted upon to the inch when the lap is light; besides when the lap is heavy, the amount of fibres to be acted upon is not the only thing to be considered, the injury to the fibres being the most important.

Also, a heavy lap makes the danger of the licker-in plucking the sheet of lap in tufts more likely. So we advise to set

THE FEED PLATE

from the licker-in teeth at 10-1,000 gauge for a lap 9 to 10 ounces to the yard, 12-1,000 for a lap 11 to 12 ounces and 15-1,000 for a lap 12 to 14 ounces.

No matter what kind of work is run, the lap should never weigh over 14 ounces to the yard, because the extreme delicacy of the fine points of the card clothing should be kept in mind, and for others reasons that we will explain later.

One point we wish to give to the reader is to consider the effect of using a fine comb on a thick head of hair; there surely would be a battle which would break first, the teeth in the comb or the hair. On the other hand, if a fine comb is used on a human head of much less hair, only a slight resistance to the comb teeth is offered without injury to the comb or hair. So it is the same with a heavy and light lap.

The difference in the various feed plates used is another important con-

sideration. For instance, when using one-inch cotton the distance from the nip of the feed-roll and bite of the licker-in teeth should be 1⅛ inches, and when using 1⅛-inch staple the plate is made so that this distance is 1¼ inches, and so on, having the distance between the nip of the feed-roll and bite of the licker-in one-eighth of an inch longer than the staple being used. In order to receive the full advantage of the feed plate, it must be shaped to

SUIT THE STAPLE

of cotton that is being worked, so the gradual and not the sudden detachment of the fibres should be the aim at this point.

Another point about the feed plate is that its good settings can be destroyed by the weights that produce pressure of the feed-roll on the sheet of lap. Some of those weights rest upon levers having notches so that the weights can be shifted from one notch to another. Happily these weights are stationary on most cards.

When the weights are shifted and the pressure upon the sheet of lap is too light, the action of the licker-in will pluck the cotton from the feed roll before it should. Sometimes very large tufts are taken and conveyed to the cylinder, with the result that much injury is done to the licker-in screen and cylinder wire. Besides, the finer parts of the card are called on to do this heavy work that should be done by the licker-in, thus making the work very uneven, and many of the tufts remain in tangled flakes that can be seen in the web coming from the doffer of the card. No. 17.

XVIII. CONDITION OF LICKER-IN.

We have explained that the licker-in teeth play through the fringe of fibres hanging downwards at a very high velocity, and also that the saw-toothed fillet is preferred, which is inserted in spiral grooves in order to scatter the teeth over the shell of the licker-in. It is necessary to understand why the writer has admitted elsewhere that setting the licker-in very close will not injure the fibres. The licker-in teeth pass through the fringe of fibres at such a high velocity that if they are not scattered over the shell of the licker-in a tooth will strike the fringe of cotton exactly where the previous one struck, thus injuring the fibres. In order that this may not happen, several separate spirals are laid side by side, the distance between two rounds of any one spiral being one inch. There are five to ten spirals side by side, according to the kind of stock used or the class of work for which the card is intended. It can be seen from the above that, as the teeth of the licker-in pass through the fringe of cotton, a lateral action is obtained at all times, which makes it impossible for the fibres that have received a combing action from one spiral of teeth to fall or come back to the same groove.

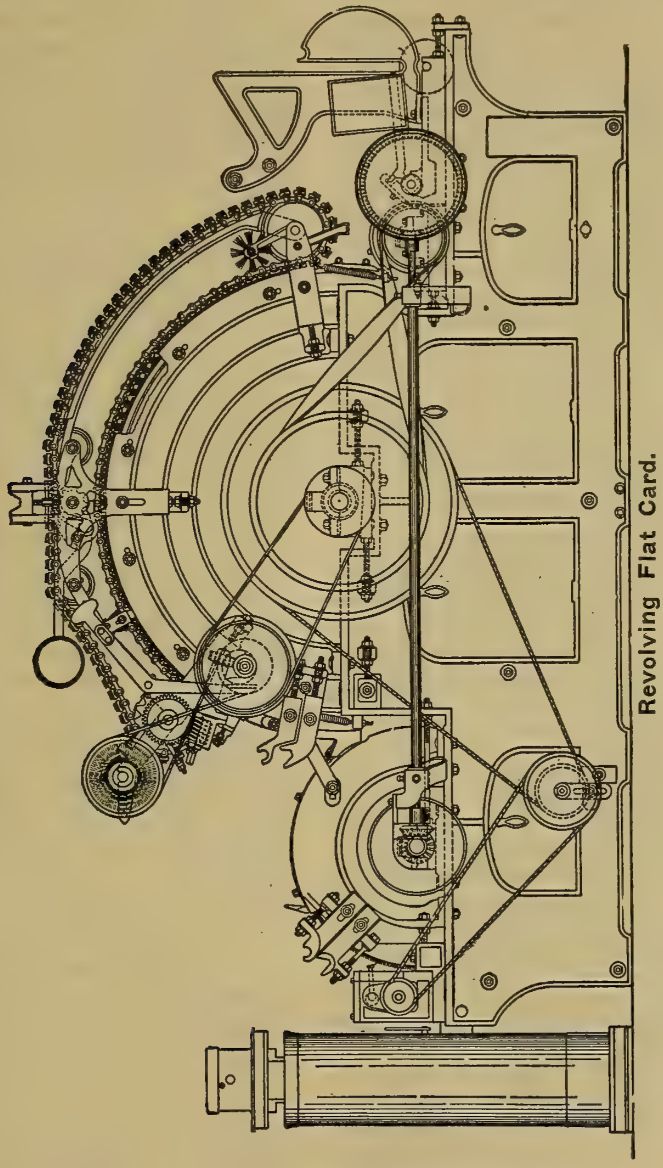
It can likewise be seen that the fibres are not straight when hanging over the nose of the feed plate, as most all writers and text books tell us, but instead are always diagonal.

The reader should easily see that the work from a saw-tooth licker-in will not injure the fibres if the distance from the nip of the feed roll and the bite of the licker-in is one-eighth of an inch longer than the staple being used.

With a licker-in covered with ordinary fillet one tooth will strike the fringe of cotton exactly where the previous one struck. It will also take the cotton around a second time and this must injure the stock.

The licker-in has a surface speed of about 1,000 feet per minute, and thus if a portion of the cotton is taken around a second time much stock is injured. So, reader, if you are an overseer or card grinder, do not lay a brick or file upon the teeth of the licker-in, because this will cause more nips and flakes than any other evil. If the reader is a bit skeptical on this point, sharpen the teeth of one of your licker-ins, and then remove the door in back of the card and look at the place that was sharpened. You will see that a portion of the stock will follow these teeth.

We are ready to admit that a licker-in is treated with a brick or file with the best of intentions, and will cause the teeth sharpended to bite more. If,



however, the overseer or grinder knew the trouble that it gives the man at the helm, we know he would not do it.

Keep your licker-in in good condition, and when in need of repair, send it to a proper place to be covered, and you will receive better results.

Remember this, that if the teeth of the licker-in are in good condition the cotton can be easily removed from the saw-tooth with the hand, but if the teeth are roughened or if the licker-in is covered with ordinary fillet, the cotton is not so easily taken out.

The above test can readily be made at any time. Take a small tuft of cotton and press it into the teeth of the licker-in covered with a saw-tooth, and then pass the hand over this tuft of cotton; it will be found that it can easily be removed, but if a tuft of cotton is pressed into ordinary wire, it will be found, in some cases, necessary to employ a card wire knife to remove the tuft of cotton. We feel that we cannot lay too much stress upon this point, as this is one of the worst evils, and causes more trouble than any other inside a cotton mill.

The object of the mote knives is to remove all portions of matter other than cotton, but in order to accomplish this, no air should be allowed to enter at the back of the card, because mote knives are useless if the card is not properly packed—even the doors at the side and at the back of the card should be closely fitted.

The above is an important consideration, because the fringe of cotton is held by the feed roll, and the licker-in teeth pass through it, and take the cotton as it is released past the mote knives and licker-in screen to the cylinder. Any short fibres, however, that are not sufficiently long to be secured by the licker-in teeth, and portions of foreign matter fall through the space between the mote knives. When the back of a card is not properly packed, the velocity of the licker-in creates an air-current which is the cause of hulls, husks and bearded motes finding their way to the cylinder. However, when the card is properly packed, there is more of a field formed by the short fibres and small particles leaving the teeth of the licker-in which are struck by the mote knives and fall to the floor. On the other hand, if air is allowed to enter the back of the card, it can be seen that no field exists about the licker-in, but instead a current is formed from the opening at the back of the card, and with the help of the current that always exists around the licker-in, all short fibres and foreign matter follow this current to the cylinder, and are afterwards found in the sliver, on the roller beam at every process, and in the cloth. No. 18.

XIX. SETTING LICKER-IN.

Most all overseers know that the loss of all cotton known as fly is beneficial, because it makes the cotton that passes forward more uniform in length, and besides, if the short cottons, too short to be worked, are not removed at this point, they will leave the sliver at other processes, and fly about the room, and collect around the trumpets of the sliver and ribbon lap machine and drawings, and thus being drawn in a bulk from the suction of the trumpet, make a bushy looking place in the drawing sliver. Here is where the good overseer counts. He has room and opportunity to give his employer the best that is in him by removing this so-called fly at one time, and preventing the loss of good cotton at another time. Our text books and writers give us a certain gauge setting at this point, and many overseers follow the rule regardless of whether the stock is clean or dirty, and the length uniform or otherwise.

The overseer should think more of how he can save cotton for his employer than of the settings.

In other words, instead of accepting a certain setting as the best one, do a little experimenting, aiming to do all you can to benefit other departments. This will make work easier for many operatives and will mean a saving for your employer.

WILL NOT AGREE.

I know that many readers (especially carders) will not agree with me, and will say that it is too much work to change the settings. If the carder would have two gauges made for the nose of his licker-in, and set as I suggest, that is, when the cotton is not of a uniform staple, he will find that it is very little trouble. Try it, if only for two different mixings. The writer employs the following method: When the cotton is very poor, the nose of the licker-in is set at three-sixteenths of an inch gauge;

when the stock is dirty and not uniform, the setting is one-eighth of an inch, and when the stock is both uniform and clean the nose is set as close as possible. The front edge of the licker-in screen, at the point where it is hinged to the cylinder screen, is also set as close as possible. The reason for setting so close at this point is to destroy the current of air that exists always around the surface of the licker-in, thus giving the impurities a better opportunity to leave this current.

It is almost impossible to make an accurate setting with the licker-in in position when setting the front edge of the licker-in screen, and the best method to set at this point is to use the quadrant gauge. Of course, it should be understood that this setting should never be disturbed, and if properly made, its setting will not be changed enough when the setting at the nose is disturbed to be taken into consideration. However, a good rule is to set the front of the licker-in first, and then the nose as close as possible, so that when the nose of the licker-in is set away from the latter the front of the screen will be lowered. On the other hand, when using the quadrant gauge, if the front of the screen is set as close as possible, when the nose of the screen is set at three-sixteenths of an inch away from the licker-in, there is always danger of getting the front of the screen too close, when the nose of the licker screen is set closer to the licker-in.

No. 19.

XX. SETTING MOTE KNIVES.

The setting of the mote knives is given by most writers and even builders as 12-1,000 for the top mote knife, and 17-1,000 for the lower mote knife.

Now, why the bottom mote knife should be set at 17-1,000 is a point I could never understand. In the textile school, the reason given is that when set too close only a small tuft of cotton will stop the licker. Granted that it does, is it not much better to set both mote knives as close as possible, and have them act as a thread guide on the spooler, that is, to prevent tufts of cotton from passing under their action, as the guides on a spooler prevent knots from passing their action and injuring the cloth, as the large tufts of cotton will injure the card?

When the large tufts of cotton are allowed to enter the card, we save the mote knife and injure the licker-in screen, the cylinder screen (at the back), the cylinder wire and many times the flats have been broken by very large tufts of cotton having entered the card, especially when a lap is allowed to run out.

Is it not much better to set the mote knives as close as possible, so as to check the licker-in and prevent the tuft of cotton from being conveyed to the cylinder.

Again, the hoops from the bale, and sometimes spikes from the lifting apron find their way to the licker-in, and if the mote knives are set very close, the other parts of the card are saved, thus saving time, labor and production. Of course, the mote knives are injured at times, but a good method is to have at least two sets on hand, so that if they are injured in any way, they can be sent to the builder for repairs.

ANOTHER CONSIDERATION.

Another consideration in setting the mote knives is that, even if the tufts of cotton allowed to enter the card do not injure the card, it surely will disturb the setting.

Set the mote knives as close as possible to save the card. The licker-in should be set to the cylinder with a 12-1,000 gauge. Most writers, and even textile schools, give this setting as 8-1,000, which is wrong. We can give a reason for setting at 12-1,000, but it never has been explained to the satisfaction of the writer why this part is set at 8-1,000.

The reason why we advise setting the licker-in at 12-1,000 is simply because there is no combing action at this point. As stated before, stock can be easily removed from a saw-tooth licker-in by passing the hand over

it. Surely, the wire on the cylinder, traveling at a speed velocity of about 2,000 feet, is more effective than a human hand, and it should be seen that a close setting is not necessary at this point. On the other hand, if the setting at this point is as close as 8-1,000 (and some advocate a still closer setting), when large tufts of cotton escape the mote knives, much damage is caused by disturbing the setting of the licker-in that will cause the teeth to wear through the licker-in screen, and also injure the cylinder wire to such an extent as to require recovering. The setting of the flats is also very important, and, like the setting of the feed plate, is much misunderstood. No. 20.

XXI. CARD SETTING.

Many writers of the present time give the following settings: At the first setting, acting first upon the cotton at 11-1,000; at the second point, 10-1,000; at the next point, 9-1,000; at the next two, 8-1,000. Others give a different number of gauge but most writers of late do set and advise to set farther away at the first and second setting point, first acting upon the cotton; but all they give us is the settings, they never give us reasons, and many young students accepting this theory as a great and general rule, set as above and let it go at that. The only reason the writer can give for the sparker to this idea, is that some worsted overseer conceived the idea that cotton could be treated the same as worsted. It should be remembered that the cotton staple never exceeds 2 1-25 inches in length, while worsted wool is sometimes 18 inches long, at least a part of it.

We will first give the reason why all flats should be set alike, which is easily explained. Granted that the lap has been properly treated, and does not exceed 12 ounces to the yard, 40 inches wide, the flats should be set at 10-1,000 gauge, because every top should do the same amount of work, and rememoer that the flats are not stationary. So if we set away at the first setting point to save the flat or the cotton, a great mistake is made, because if it is to save the wire on the flats it is only a matter of the flat travelling a few inches before it gets the bulk of the cotton. Again if the licker-in conveys to the cylinder a certain amount of cotton to be passed under the flats, and the first flat is set away from the cylinder, the flats at the last setting point are called on to do the bulk of the work; in other words, the amount of cotton taken from the licker-in has to pass in a certain space, and that the flats nearest the cylinder will get the bulk of the work, no one can deny. On the other hand, by setting the first flats away at the first setting points, the working carding surface of the cylinder is reduced, and the only excuse that can be advanced for such a setting is that the fibres are in a tangled state and that the combing should be gradual. This is all theory, not practice, and my advice to the carders who conceived the idea that this kind of setting disentangles the fibres, is to pay a little more attention to the back of the card.

All overseers and writers who believe in this so-called progressive setting admit that no injury to the fibres will result if the distance between the grip on the staple and the bite is one-eighth of an inch longer than the staple.

Now measure the distance from the edge of the flat (the heel of the flat) that grips the cotton to the edge of the next flat, and it will be found that this argument that the cotton is injured by not receiving a gradual combing is a weak one.

So if this idea, that by setting the first flat as close as the next working flat injures the staple, then every one of us must admit that we injure the staple from the nip of the feed roll and the bite of the licker-in. Our aim is simply to point out this defect for the good of all concerned, and the sooner those who believe in a progressing setting are brought to the

mourners' bench the better—even for themselves. No. 21.

XXII. PROGRESSIVE SETTING.

Progressive setting is not a new idea, for this method of setting was employed when the stationary tops were in use. The tops at that time were caused to assume an angular position relative to the cylinder, as in the present time, which was the proper thing to do. At that time, the tops first acting upon the cotton were set to a 13-1,000-inch gauge; the middle tops, 12-1,000, and the front tops, 11-1,000 of an inch. In those days the tops were nearly double the width they are at present, and so it was discovered that the detachment was as contention of progressive setting if the distance from heel to heel was not so great. A reference to Figure 1 will enable the essential parts of the card to be understood by the reader. Referring now to Figure 1 at F, it will be seen that the distance from the heel of one flat to the heel of the next flat is one and three-quarter inches, and by close observation, it can be seen that the flats assume

AN ANGULAR POSITION

relative to the cylinder. The edge of the flat, called the toe, is the edge farthest away from the cylinder, and the side of the flat nearest the cylinder and used for setting purposes is the heel, which is about 3-100 of an inch nearer the cylinder than the toe.

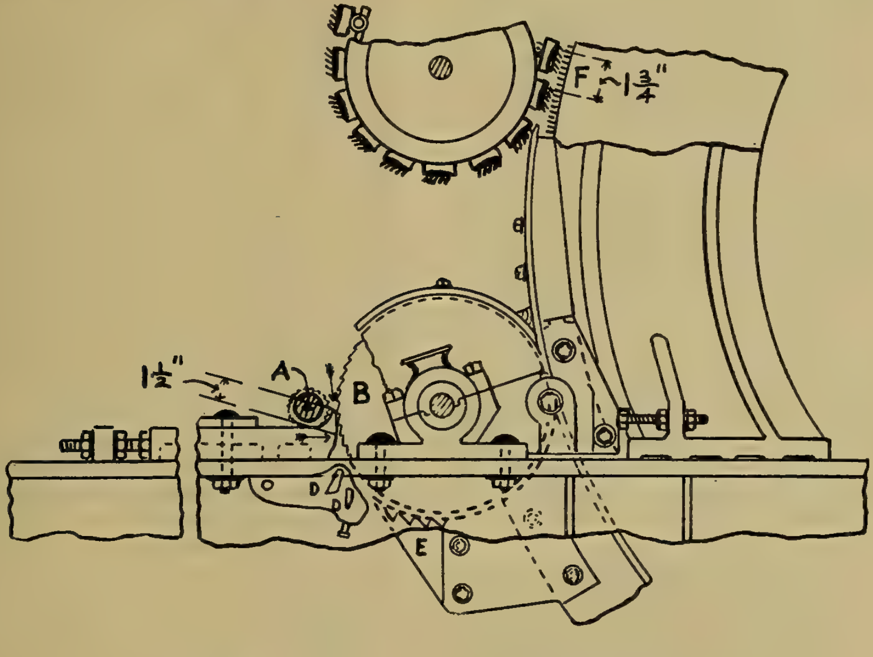


Figure 1. Portion of Revolving Flat Card.

gradual with the tops set at 11-1,000 of an inch, as when set at 13-1,000, also that more combing action was received from more carding surface; so progressive setting was abolished. This has all been forgotten, but many writers and carders would have us do what has been abolished years ago.

There might be some force in the Again, referring to Figure 1, at A, the feed-roll, and C, the feed-plate, the top arrow shows the grip of the feed roll, and the lower arrow shows the bite of the licker-in teeth. The distance given in the drawing is one and one-half inches, and this distance will be found to be less with the majority of feed plates that are now in use.

As was stated elsewhere, the only reason for setting the flats first acting upon the cotton away from the cylinder, is to give the stock a gradual combing, on account of it being in such a tangled state, so as not to injure it. As stated before, it is safe to say that all writers and carders agree that no matter how close the feed-plate is set to the licker-in, provided there is no contact, no injury will result to the fibres, if the distance from the grip to the bite is greater than the length of the staple.

Any reasonable person will grant that the fibres conveyed to the cylinder by the licker-in are not in such a tangled state as when presented to the licker-in. Granted that they are not, and the two distances are considered, that is, the distance between the grip of the feed roll, and the bite of the licker-in teeth, how can the fibres be injured? Surely, as stated before, if the

FIBRES ARE INJURED

at point F, Figure 1, they are also injured between A and C. Another point we wish the mill men to consider is, that the longer the staple of cotton, the more tangled it will be; and this, no mill man will deny. Again, where the longest staple of cotton is used, we find the closest setting of the flats. We find to-day in our fine goods mills, that every time a card is ground, all flats are removed from the card, and ground on a special machine, so as to enable a setting of the flats of 3-1,000 of an inch.

Now, let us reason together here, for the reader will surely agree that if the writer is wrong in not accepting the method of progressive setting then these men in the fine goods mill are making a terrible mistake, because, besides setting the flats much closer, the staple of cotton used in some of these fine goods mills exceeds two inches. Now, reader, stop and think; here we have a staple, say, two inches long, which is greater than the distance between the heels of the flats of any revolving flat card, and set to a 3-1,000-inch gauge to the cylinder. It can be seen that if it is true that when the flats are set close to the cylinder at the point where the cotton first strikes the flats injures the stock, then the same is true between the grip of the feed-roll and the bite of the licker-in teeth, and also true where a staple of cotton exceeds the distance between the heels of the flats, on account of the two heels having the same opportunity of .

GRIPPING THE FIBRES.

When the statement was made, (which is a true one), that yarn possesses a certain strength which arises to a large extent from one factor, viz., the number of fibres in its cross section, most carders accepted the meaning, with the result that in the majority of our carding rooms is found a heavy lap. Why a carder fails to see the injury caused to the staple when running a heavy lap, is more than the writer can understand. (1.) No one will deny that when running a heavy lap, the licker-in has a better opportunity in plucking the cotton in large tufts. (2.) It should be borne in mind that it is much better to make your feed-roll revolve faster and save the cotton, than to have the feed-roll running slowly, and the licker-in teeth pulling the fibres away from one another, which results in injury to the fibres. There is no excuse that can be offered for running a heavy thick lap, because a thinner lap can be made which will weigh the desired amount, due to its greater length and more compact winding. Similarly with roving or yarn, the compactness of the bobbin is increased by using finer yarn. The same with roving or yarn—the finer the hank, the more compact the bobbin will be.

Here is the difference when running a light lap. (1.) The picking machinery does the heavy work it should do, because, in order to make a light sheet of lap, the cotton must be broken into smaller tufts, which cleans the cotton of the heaviest impurities. (2.) The fluted calender rolls make more revolutions, and of course, the picker-room does not turn off as much production, and the lap contains a larger number of yards. When the feed-roll

is made to revolve as fast as possible, and the sheet of lap made correspondingly lighter, a gradual detachment takes place between A and the lower arrow, Figure 1. No. 22.

XXIII. CARDING ACTION.

We have stated elsewhere that no air should be allowed to enter the card, because the

EXISTENCE OF AIR

currents plays an important part in the work of a card, as was pointed out; for the velocity of the licker-in is so great that a field is caused by the short fibres, and impurities have a tendency to fly outwards, which are struck by the mote knives. The reason we give the setting of the licker-in so close is to destroy as much as possible the current that always exists around its surface. Referring to Figure 1, E is the nose of the licker-in screen. The setting at this point is given elsewhere, and by following the drawing to where E is hinged, it can be seen that a close setting is beneficial, because the less space allowed at this point, the weaker the current around the licker-in; and the weaker the current, the more of a field is caused above the mote knives by the short fibres and dirt flying outwards, which are struck by the mote knives, and fall to the floor.

The modern revolving flat card is constructed so as to secure the largest per cent of production possible. To attain this object, the manufacturers have decided that 165 revolutions of a 50¾-inch cylinder, (including clothing), is the proper limit, which is around 2,000 feet velocity per minute. This limit is set on account of the

CENTRIFUGAL ACTION

on the cotton fibre. Although it is certainly true that the velocity of the cylinder is so great that the fibres, if left at liberty, will tend to be thrown outwards, too much stress must not be laid upon this point.

The cylinder having a surface velocity of about 2,000 feet per minute, it should be plainly seen that when the fibres are drawn past the space of one and three-quarters inches, (from heel to heel of each flat) that it seems unreasonable to ask anyone to believe, as theory tells us, that the fibres held by the cylinder wire, and to a certain extent raised from the surface, are subjected to the combing action of the superposed teeth, their free portion being drawn along the points of the flat, and thus cleansed. The above statement is right, but it must be understood that the free portion of the fibres are drawn along the points of all the flats.

The theory that the flats are caused to assume an angular position relatively to the cylinder, so that the free ends of the fibres will strike the toe of the flat and be drawn through the wire teeth on each flat is

WRONG IN PRACTICE,

for with material as light as cotton, it is impossible for the free ends of the fibres to strike the toe of each flat, receive a combing and be ready to strike the toe of the next flat; and when it is borne in mind that the cylinder is travelling at a speed velocity of about 2,000 feet per minute, and the free ends of the fibres are travelling at almost the same velocity (depending on the grip the cylinder retains upon the ends of th fibres), passing a space of 1¾ inches, it is, as stated above, impossible for the free ends of the fibres to strike the toe of the flat while passing this short space at such a high velocity. No. 23.

XXIV. POSITION OF FLATS.

In order to study how the free ends of the fibres receive a combing action from the flats, it is necessary for the student to fix firmly in mind that the velocity of the clyinder is so great that the fibres, if left at liberty, will tend to be thrown outwards. Then he should picture in his mind that the extent of their outward position depends on the distance that the flats are set from the cylinder, and that they do not change their position as theory tells us at each flat, but remain in

the same position while passing under all the flats, unless injured or held by the wire teeth on the flats.

The chief reason why the flat is given

AN ANGULAR POSITION

relative to the cylinder, is not to give a combing at each flat, but instead to insure that the fibres will readily enter the space beneath the flat, and preclude the possibility of rolling up of the fibres at the front of it. Again, what was said about a field caused by the short fibres and impurities flying outwards at the licker-in holds good here, only instead of the short fibres and impurities being struck by the mote knives they readily enter the space between the flats, and are not allowed to follow the cylinder by coming in contact with the toe of the flat and lodged until stripped by the stripping comb.

If a particle of matter is placed upon the surface of a swiftly revolving cylinder, the particle will continually jump and follow the air current created by the high velocity of the cylinder, until it finally leaves its surface.

So it can be seen that the actions of the small impurities are similar only they are not at liberty to leave the cylinder, but instead they readily enter the space that the angular position of the flat occasions.

We stated elsewhere that there is a dual operation going on at all times between the teeth of the wire on the cylinder holding the ends of the fibres for a certain length of time, and the teeth of the wire on the flat holding the fibres for a certain length of time, and the reason was given why the greatest number of fibres were conveyed to the doffer.

Very few carders and writers will agree with me upon this point, because most all books on textiles, writers and

TEXTILE SCHOOLS

tell us, that the ends of the fibres are held by the wire teeth of the cylinder and the free ends are drawn through the wire on the flats, and the ends held by the wire teeth of the cylinder receive their combing when the detachment of the fibres takes place at the doffer.

Now, reader, is it possible when the number of teeth on the licker-in and cylinder and their respective velocities are considered, to render it practically possible for each point on the cylinder to take up at each revolution one fibre? Still, this is what most carders and writers tell us it is supposed to do. The licker-in has much less teeth to the square inch than the cylinder which, besides having a greater number of teeth to the square inch, its surface velocity is doubly greater than that of the licker-in. When the above is considered it should be seen that it is more than probable that there are considerable periods—that is, comparatively—during which the teeth in various parts of the cylinder do not take up any fibres at all. Another proof in regard to the dual operation that the writer claims is always going on between the teeth of the cylinder wire and the teeth of the wire on the flat, is that if the stripping plate is moved away from the cylinder, much long staple will

FOLLOW THE FLATS

to the stripping comb.

A properly made card tooth should only grip the fibre for a short distance and the hold which it retains upon it will depend very largely on the way the card is ground, that is to say, the point of the wire teeth on the cylinder and flats should be sharp and clean.

In the very fine goods mills where the flats are set as close as 3-1,000 of an inch, (especially in New Bedford, Mass.) the fibres are not injured from such a close setting, for the reason just given, that is, to have a properly made card tooth that will grip the fibres for only a short distance.

It can be seen from the above, that the fibres are not injured, as the grip on the fibres is retained only for a short distance, which proves the claim of the writer; because if the wire teeth retained their hold upon the fibres, as theory tells us they do, while passing under each flat, it can be seen

that when the keen teeth of the flat bite the free ends of the fibres, the latter would be broken or injured. Again, if the teeth on the wire of the flats and cylinder are not sharp and clean, and the space between the heel of one flat to another is not considered, which is 1⅜ inches for running a staple of 2 inches or more, it should be seen that the staple of cotton would be injured or broken.

The writer is pleased to say, however, that this is not the case in our fine goods mill, because due regard is given to the grinding. When a card is ground the flats are ground on a special machine and ground to a certain gauge, all alike. The above method is employed in most New Bedford (Mass.) mills where the quality of yarn turned off is a credit to the city. No. 24.

XXV. SETTING FLATS.

The flats have to be set very close to the cylinder surface, and this is a matter which involves the consideration of one or two points. When the stock is weak and fairly clean, set all the flats at a 10-1,000-inch gauge; if the stock is full of neps, hulls and husks, set as close as possible. In setting the flats to the surface of the cylinder as close as possible, the carder should choose a time when the mill is stopped in order to eliminate vibration. Then by means of the setting screws, by which the flats may be raised or lowered, he lowers the flats until by slowly turning the cylinder, a light click, caused by the wire teeth of the flat coming in contact with the wire on the cylinder, can be heard. Then the setting screws should be reversed to destroy this contact, and the setting screws locked with a check nut.

It must be understood that the writer advocates the setting of the flats in all print cloth mills at 10-1,000 of an inch. The above close setting is given just to point out that the closer the setting, the smaller the amount of neps that can be seen in the web. Again if a clean grade of yarn is required and no combers are available, the above

CLOSE SETTINGS

will be found advantageous in such a case.

One point the writer wishes to convey to all carders, is to instruct their grinders when setting the flats, whether by ear or by gauge, to always lower the flats so that the setting screw must be reversed. The mistake of not doing this has cost many mill men many dollars, and also many hours of worry. When the flats are lowered and not reversed, they are liable to drop at a lower point than they were set, because there is always vibration existing in a mill when running, and this vibration combined with the weight of the flats on the flexible bend, and the little play that may exist in the setting arrangement, causes many times the flats to dip into the cylinder, which raises the wire on the cylinder to such an extent as to require recovering.

On the other hand, if the setting screws are turned to lower the flats until the gauge is tight between the flats and the cylinder, and then the setting screws reversed, it can be seen that all possible play in the setting arrangement is removed, and the danger of the flats dipping into the cylinder is avoided. Making first a tight setting and then reversing the setting screw applies to all strong points on a card, and will be found to be

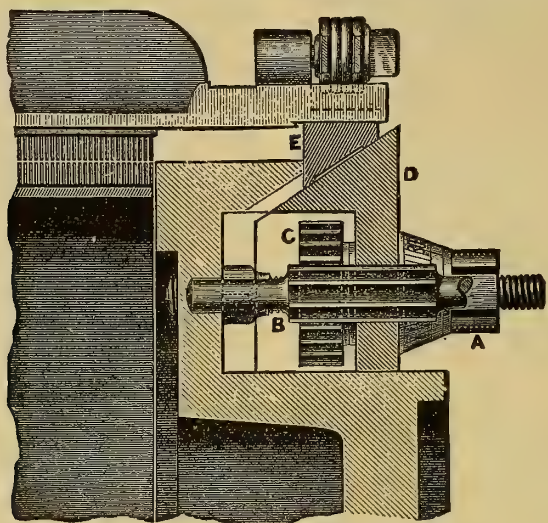
THE SAFEST METHOD.

When the flats are dipping into the cylinder, a streak can be noticed on them, caused by the staples clinging to the injured points of the wire on the flats. The cards should be stopped immediately and if the clothing is blistered in any way, have the cylinder redrawn, and do not try to run a cylinder in such a condition, because a close setting can not be obtained, besides, danger exists always of the fillet breaking when in this condition, and doing much damage to other parts of the card.

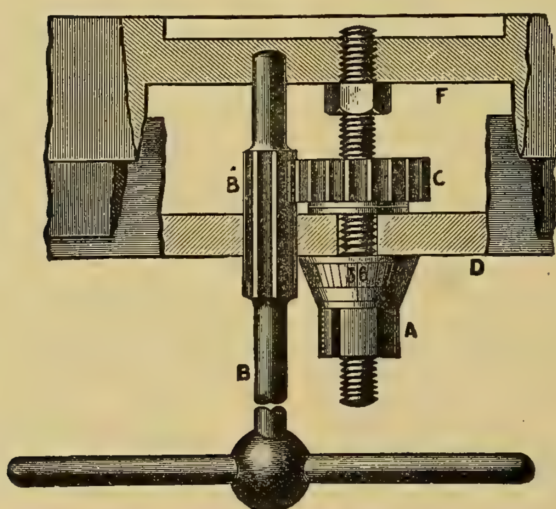
The manner in which the flats may be raised or lowered varies on different makes of cards; one method is shown

in Figure 2 which illustrates sectional and plan views of this arrangement.

The flats are supported by a flexible bend in the usual manner, but the method of supporting the flexible bend is a radical departure from others, the only resemblance being the setting points on each side of the card. By referring to Figure 3, it can be seen that the under surface of the flexible bend is beveled and rests on the beveled surface of the rigid bend. It should also be seen that when the bend is forced in toward the cylinder the bend must rise, while on the other hand, when the rigid CONICAL BEND is forced outwards, the flexible conical bend must fall, thus raising or lowering the flats as may be desired. A is



SECTIONAL VIEW.



PLAN VIEW.

Figure 2. Setting Arrangement for Flats.

the index nut which bears against outside of rigid bend D and locks nut C. B is a setting key with fluted teeth, which gears into the teeth of nut C, which is used for the setting of the flats. C is a toothed steel nut which bears against the inside of rigid bend D. E is the flexible conical bend which rests on D and supports the flats.

As the index nut A and the toothed nut C are turned one way or the other, they move the rigid bend D in or out, and thus raise or lower the flexible bend as explained.

Each division on the index nuts A represent 1-1,000 part of an inch, and by turning these nuts one division, the flats are raised or lowered to this extent.

Another arrangement for setting or adjusting the flats is shown in Figure 3. The bend A is supported by brackets, which in most cases are composed of two parts, A1 and D. In Figure 3 the outer portion, A1, is shown in dotted lines. The inner portion, D, is so made that a projecting lug, B, fits into a hole in the bend and holds it in position. The part, D, is supported by a screw that passes through the rib, H, of the arch and carries two set nuts, F. and G, one above and one below the rib. The bracket is also held in position by the screw, E, which runs through a slot in the bracket and

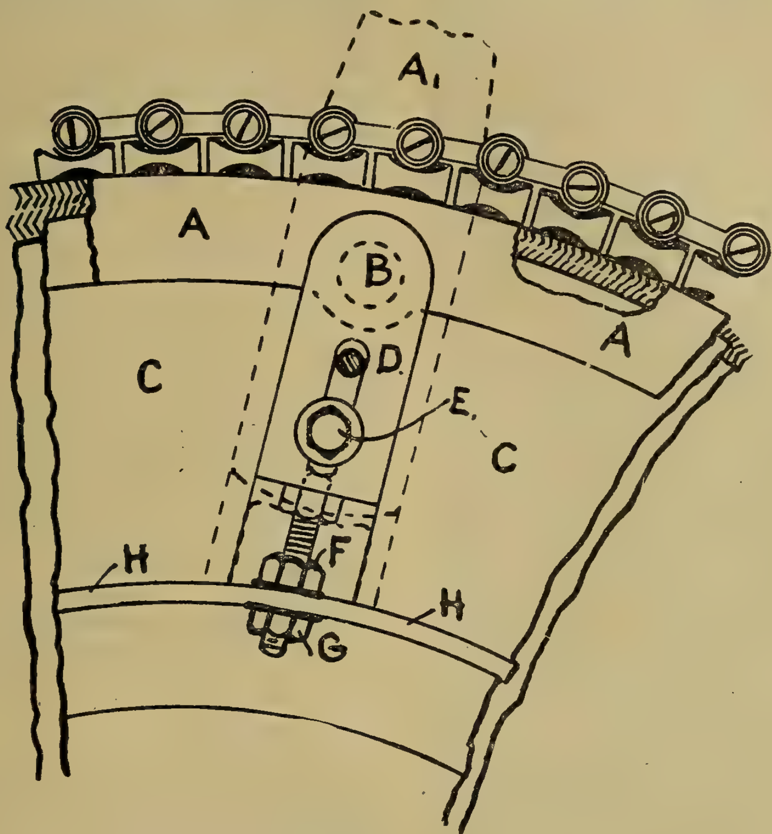


Figure 3. Arrangement for Setting th e Flats.

ENTERS THE ARCH

of the card. On raising or lowering the bend, A, by means of the bracket, D, it can be seen that the flats are raised or lowered as desired. The setting of the doffer is also important, and like other settings already explained opin-

ions differ. One mistake we wish to point out, and one that is made in most mills, is the copying of the settings of another mill. No. 25.

LESSON XXVI. CARD CLOTHING.

The setting between the cylinder and doffer is given by machine builders and writers as 7-1,000 of an inch, which is all right for certain kinds of stock, while for other kinds of stock this setting would be too close, and for still others this setting would be too wide. In the fine goods mill they set the cylinder from the doffer with a 5-1,000-to do.

Elsewhere we have advised covering the doffer with 140's wire, the cylinder with 120's, and the flats with 130's. The reason for covering the doffer with such a fine wire, is for the same reason as setting the doffer close to the cylinder, which is to preclude the possibility of the fibres passing the doffer, and being taken around a second time or dropping through the cylinder screen to the floor, which is a great loss to a mill, because long stock is so valuable. It should be seen that with a close setting at this point, and the doffer fillet having a much larger number of points to the square inch than that of the cylinder, a better opportunity is given to the doffer in detaching the long fibres from the cylinder. On the other hand, when the stock is short and dirty, a setting of even 7-1,000 of an inch is too close, because the doffer

WHEN SET CLOSE

and using dirty stock, will act as a stripping roll. The writer has been condemned many times for making such a statement, but if I am wrong, let me ask how it is that the yarn in mills using dirty stock is so dirty and also why it is that hulls, husks, leaves and other impurities are found on all roller beams throughout the mill? Surely they are combed from the doffer, and the only way to stop much of this foreign matter from going through, is to set to about 9-1,000. Of course, it is very seldom that the setting between the cylinder and doffer in any print cloth mills, is other than 7-1,000, which we recommend also, but as stated when the stock is extremely dirty, the best results are obtained from the above setting. Another evil that bothers many carders, is when the web is dotted with white specks, which can be plainly seen but are neither motes nor leaves. There is not much doubt that these are neps formed from damaged or broken fibres, caused either by having a wrong nose-feed plate, a dull licker-in, or a licker-in that has been sharpened with a brick or file, which became knotted or matted together, and escaped the cleaning of the flats.

Another defect we wish to point out is running a card with flats covered with coarse wire. The writer has in mind two mills that are at this writing running their cards with 80s wire on the flats. Here is the explanation to this defect: When the cylinder receives the fibres from the licker-in teeth, many become overlaid and matted, and it is quite clear that if the space between the points is great, that the fibres are not laid in parrallel circumferential lines, as in the case of fine wire, and they are deposited transversely on the doffer, thus besides giving the cylinder a better chance in taking such fibres by the doffer around a second time, the rolls are unable to draw fibres in such a condition in after-processes.

No. 26.

XXVII. FURTHER SETTING.

When setting the cylinder screen, care should be taken to only loosen the bolts passing through the side arches, and not loosen the arch bolts. Set the cylinder screen farther from the cylinder at the front than at any other point, the reason for this setting being so that the long fibres that escape the wire teeth of the doffer will not come into contact with the front edge of the screen, and thus be removed from the cylinder to the floor. The front edge of the cylinder screen should be set at 25-1,000, the

centre at 30-1,000, and the back at 11-1,000 of an inch. The reason for

SETTING SO CLOSE

at the back of the cylinder screen is for the same reason for setting the front edge of the licker-in screen; that is, to destroy the draft caused by the high velocity of the cylinder. The setting of the front knife plate is important, and, like the nose of the licker-in, should be set according to the length of staple run. When running a long, clean staple, set the front knife or stripping plate so that the "strip" from each flat are all one thickness, and held together by fibres here and there. It should be remembered that the amount of flat strippings depends to a great extent on the setting of this plate. If the plate is set too close, some of the short fibres and foreign matter removed from the cotton by the flats, and by the help of the knife, the cylinder will carry to the doffer, thus producing bad work.

As stated before, it is by watching these settings that the overseer in charge can save many dollars for his company—and why not do it? It is just as easy to set this plate right as wrong. The back knife plate is seldom, if ever, set by any grinder or overseer, because this plate once set is never disturbed. However, it should be examined to see if it is properly set, which should be 17-1,000 at its lower edge, and 32-1,000 at the upper edge. The reason for setting the upper edge of the back knife plate away from the cylinder, is to give the cotton, conveyed to the cylinder in

A MATTED STATE,

a chance to free itself and stand out a little from the cylinder before coming in contact with the flats.

The flat stripping comb should be set at 8-1,000 gauge, and care should be taken that it is not set too close as to come in contact with the wire on the flats, because this is liable to damage the comb as well as the wire on the flats. Nothing looks so bad in a card room as the flat stripping comb held in position for a time by striking the flats, or the comb moving and holding the flat so as to give it an intermittent action. When setting the doffer comb, the blade should be brought at its closest point to the cylinder, and then set to 10-1,000 gauge. When the web follows the doffer, as is the case in cold weather, caused by the room getting cold, the comb should be raised a little and set to 8-1,000 gauge. In the summer, when the web is sagging, the comb should be lowered, and set to 10-1,000 gauge When a very heavy lap is run, sometimes it is impossible to stop the sagging, and the only remedy is to make a lighter lap.

When setting the doffer comb, great care must be given that the teeth of the comb do not come into contact with the wire teeth, or points of the doffer, because it will roughen the teeth of the doffer comb to such an extent, that a few fibres will

CONTINUALLY COLLECT

at all the rough places on the comb, and continually break the web down. Another point that should be considered, when setting the doffer comb, is to be careful and see that all the posts holding the comb blade to the comb are the same length. The writer has visited mills where it could be seen that some part of the blade of the doffer comb was striking the wire, while in other places, part of the web would follow the doffer, owing to the posts being of different lengths.

The first thing to do before grinding the card is to determine whether the wire is plough ground or not, so as to be able to test the wire when it is supposed to be sharpened. A good method, when the wire is plough ground on both sides, to asecrtain whether the point of the wire is ground properly, is to pass the finger nail over the points of the wire. If the wire points bite the finger nails, this indicates that the point of the wire is in proper condition. When the wire is not plough ground, or plough ground only on one side, the points of the wire do not bite the finger nails as readily as the wire plough ground on both sides.

The manufacturer should be careful when

SELECTING WIRE FILLET,

and examine the point of the wire with a strong magnifying glass, to ascertain if the wire is plough ground, on both sides. Wire not plough ground, or wire plough ground only on one side, should not be accepted, because, as we understand it, plough ground wire is to be preferred, on account of its sharp sides having a better opportunity of holding the fibres until they are straightened. So when the wire is plough ground only on one side, only one half the benefit is obtained. Again, as we have pointed out, to have good carding, a dual operation must always be going on between the points on the cylinder and flats holding the fibres for a certain length of time. It can be seen by having the wire plough ground on both sides, that the fibres are held until they are straightened; thus, the fibres are laid in parallel circumferential lines, and deposited on the doffer while in this condition, which is the basis of strong yarn. Before explaining the proper method of grinding, we wish to state, that the time for grinding a card is much misunderstood, because some wire needs grinding every two weeks, while other kinds of wire need grinding only every two months.

Here is where

A GOOD GRINDER

or a good overseer is valuable to a plant, when he is able to judge the quality and temper of the wire. As stated, in grinding no special time can be given. Grinding must always be controlled by sight, ear and touch. The grinding should always be done lightly and carefully, so that the top edges of the wire will form something like the cutting edge of a chisel, but on account of the lateral motion of the grinder, the side edges will be ground off, leaving nothing but the sharp points. On the other hand, if the grinding is done in a hasty and careless manner, the points of the wire are roughened, and cause them to hold the fibres. It can be seen from the above the harm caused from heavy and careless grinding, because, when the points of the wire cling to the fibres, they carry many long fibres past the doffer, and around a second time, thus injuring the fibres. Besides, at stripping time, the card wire is not stripped as clean, because the wire points clinging to the cotton make this impossible. No. 27.

XXVIII. GRINDING NEW CLOTHING.

We have stated elsewhere that when grinding a card the quality and temper of the wire should be considered, because it is impossible to temper all the wire alike. It was also stated that the shape of the points should be considered; that is, the wire should be plough ground on both sides of the points, so as to hold the fibres until they are properly straightened. When the wire is plough ground the points are almost wedge-shaped, which is an advantage over wire not plough ground, because it can be seen that even when the extreme point is worn away, there still remains a comparatively sharp point. Again, it should be seen that a narrow point does not require the grinding time that the round points demand; besides, as stated above, when the extreme point is worn away, there still remains a comparatively sharp point, which, of course, requires less frequent grinding than the round point.

When the cards have been clothed and are ready for the grinding operation, it must be understood that the firs grinding differs somewhat from

THE USUAL METHOD

of grinding employed in the mill that has been in operation for some time. The card cylinder and doffer is first ground with the dead rolls, which are left on until the surface of the wire on the cylinder and doffer is perfectly smooth. This can be judged by the eye, because when small blotches are seen on the cylinder and doffer, further grinding is necessary until all the blotches disappear. There is no certain amount of time given for the dead rolls to remain on new fillet, because, as stated, some wire may be tempered harder than others, and the blotches on the hard wire will remain

longer than on the softer ones. After the blotches disappear, the wire has been ground level enough for the traverse wheels to be used.

There is no length of time given for the traverse wheels to be left on the card, which is to put a point on the wire, and the best method is to stop the card after three days of grinding (for a new card), and pass the finger nail over the points of the wires, and if the points of the wire bite into the finger nail, this indicates that the points are sufficiently sharp. The grinding on cards that have been in operation for a time differs, as stated with the new cards. The first thing to do is to examine the fillet, to see if it is blistered, or raised, at places; or to see if the wire on the cylinder and doffer is in any way disarranged. Sometimes when a lap is allowed to run out, or the flats have dipped into the cylinder, the edges of the fillet overlap one another slightly. In such a case, the

POINTS OF WIRE

are high at the edges of the fillet, and are knocked from their foundation when they come in contact with the wire on the flats. In such a case, the best method is to have the fillet re-drawn, because some of the wires escape the foundation of the fillet, and are lodged in different places under the coil of the same fillet, thus causing a high place. When the wire is raised in the manner explained above, and the card cannot be stopped, owing to the want of production, the best method that will replace the raised edges of the fillet somewhat, is to nail a piece of the same kind of fillet on a flat surface or small board, and sink the wire nailed to the board into the wire where the edges of the fillet are raised, and then hammer the board, thus knocking the points of the wire on the board on the foundation of the fillet where the edges are raised, with the result that the wire of the fillet strikes the surface of the cylinder, and are driven back into their foundation.

The cards are usually ground in turn, unless some accident which may face-up the cylinder and doffer, necessitates such cards to be ground out of the regular order. Again, if the grinder and the overseer are in any way observant, they will find that some cards need grinding every two weeks, while others only every two months. As stated before, this is where the experienced overseer or grinder count, because they can prevent unnecessary grinding, which wears the wire, and calls for a readjustment of the various parts of the card. The

LATERAL MOVEMENT

of the dead rolls is given to slightly grind the sides of the teeth, and leave only a sharp point on the wire of the flats. Great care should be given the grinding of the flats, because the arrangement adopted to firmly support the flat and give it a proper position must not be neglected. No. 28.

XXIX. GRINDING RULES.

We have mentioned elsewhere, that it was necessary for the flat to occupy a relatively angular position to that of the cylinder; that is, when the flats are at work, the heel is closer to the wire on the cylinder than the toe. It should be seen that if this relative position existed with regard to the grinding roll, the wire at the heel would be ground off before the wire at the toe was touched by the grinding roll; thus, the setting point would be destroyed, and the flats also.

There are many types of grinding apparatus for grinding the flats, but the principle is the same; that is, the flats are forced against a projecting piece so that the teeth of the wire on the flats will assume the correct position for grinding. It must be understood, however, that during the whole period the flats are being ground, they are moving towards the front of the card.

Referring to Figure 4, line A is the back or upper edge of the flat; line B is the bearing surface, when the flat is resting on the flexible bend, and angularly to the surface A; C is the wire surface. It must be understood that the lines B and C are given such a slant in the drawing so it can be

more readily understood. The point at C is the toe of the wire. Now, the reader should fix firmly in his mind that Figure 4 is the end of the flat when in its grinding position, and that the flats are held in position by

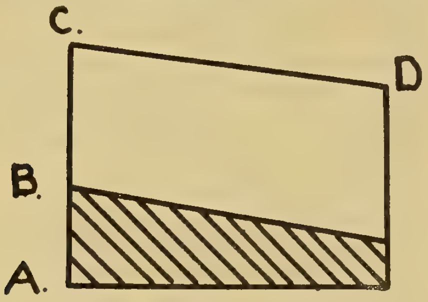


Figure 4.

a projecting piece pressing on the surface of A. It should be clear to the reader that the line A, when pressed against the projecting piece, causes a

PARALLEL RELATION

of B and C to be maintained, if A is given the same angular position relative to the flats by the projecting piece, as the bearing surface of B occupies when resting on the flexible bend. The provision of a plate with an angular surface, so arranged as to give the requisite angularity to the wire surface, is necessary, to bring the flats in their proper position. We explain the above type in a general way, so as to give the reader a general idea of how the top is brought into position without referring to any particular type. However, it must be remembered that the surface of the wire at D (the heel of the flat), is only 3-100 of an inch nearer the cylinder than the point at C—the toe of the flat. The best point in setting the flats is to begin in a proper manner, and not be hasty and spoil many dollars' worth of card fillet. The first thing to do is to break the lap back, and allow the card to run without stock for at least one hour. Then the card is stopped, and the cylinder and doffer are stripped, and the sides of the cylinder and doffer between the frame work are cleaned with a steel flat hook. The fly is then taken out from under the card, and the screens examined to see if cotton has collected between the cylinder and the cylinder screen on the first few revolutions of the cylinder.

The front of the card should also be examined, because

COTTON COLLECTED

at the doffer and doing no harm when the card is carding, may cause fire at the time of grinding, owing to the high velocity with which it revolves. The traverse wheels and dead rolls should be examined before they are put on the card, to see if the emery is in good condition. If not, cover the Horsfall grinder, but the dead roll should be sent to the shop. The writer would like to have all carders notice this point, because if they once send their dead rolls to be covered at the shop, they will never cover them again. Besides being better covered, the tops receive a more level grinding, which enables a better setting of the flats. When the Horsfall wheels are put on the cylinder and doffer, the safest and best way to avoid injuring the wire is to set the wheel so that 5-1,000 gauge can easily be passed between the wheel and the wire, because the bearings for grinding purposes are liable to be moved out of place, which has been the cause in many cases of spoiling the fillet on the cylinder and doffer to such an extent as to require recovering. Then the card is made to revolve in the opposite direction from that when carding, and then the wheels are set closer to the cylinder by ear.

The grinding should be done lightly, so that a passer-by is unable to hear the sound made by the wheels. If a grinding wheel can be heard by a passer-by when the mill is in operation, the grinding is being done too heavily. After the surface of the wire on the cylinder and doffer have been ground, so that the points of the wire will bite the finger nail when passed over them, the Horsfall wheels should be removed, and the different part set. In setting the flats,

THE HIGH TOP

should be used for the setting at all

points. All good grinders know their high flats on every card under their care. The reason why we recommend the setting of the flats with one high flat at every setting point, is to avoid the possibility of the flats finding a lower position than the position they are set at. This was explained elsewhere pertaining to the settings of the flats in reversing the setting screws when setting, so as to leave no play. Suppose that we set, like writers tell us, and even textile schools, that is, to remove two flats at each setting point and each flat set at its own point. On the other hand, if one flat is used, and it being also the high flat, (what we mean by a high flat is that the wire of the flat is always nearest the cylinder, caused by the wire being harder on this one particular flat), and it is brought at every setting point and set, and it is also ascertained that there is no dirt under its bearing surface at the time of setting, no danger exists of the flats falling to a lower level than that at which they are set. But, if we set as we are told in the first place, there may be a higher flat in the set than those brought to the setting points, and may cause much damage.

Again, if a piece of cotton or any other foreign matter has collected under the flat used for setting, or under the other flats, and the flats are set to this level, it can be seen that when the particles clinging to the flats are removed, the flat will dip into the cylinder. The writer is willing to admit that such cases do not come up often, but on the other hand, think of the damage it causes, and expense, which we have already explained elsewhere. Another point in favor of setting with only one flat, is that if there was dirt of any kind under the flat, it will lose its hold on the flat, when the flat is brought to the setting point, and then back again. The reader must understand when we say the flats are brought back that no stock whatever is on the cylinder, flats or doffer when this is done, because if the flats are turned in their opposite direction, and charged with stock, a rolling of the fibres occurs, at each working flat, which are pressed in between the cylinder and flats that block the cylinder No. 29.

XXX. FURTHER GRINDING RULES.

It is seldom that the licker-in requires grinding. When it is necessary to grind the licker-in, the carborundum wheel should be used. The licker-in teeth are made to revolve against the surface speed of the carborundum wheel. After grinding, the licker-in should be reversed, and pumice stone applied freely. By this means the teeth are made smooth, and will not take the fibres around a second time. Many writers and textile school instructors advocate using a soft brick or sandstone to the back of the teeth while the licker-in is revolving. We have explained the evil this will cause.

We are also told by most writers that, owing to the action of the plough grinding, the wire points are made rough. This is wrong, because any mill man knows what we say here is true in justice to the card clothing people, that when flats are received from the shop they are already smooth. The writer does agree that the flats should receive a little burnishing, but not as much as is done in most mills. The best way to burnish flats, and at the same time retain the point on the wire, is to cover the burnishing brush rolls with coils of burnishing fillet about five inches apart, spirally, thus having only about one-fifth the wire playing through the teeth of the flats. If this is tried by any reader, the writer would like to have him examine how the burnishing wires

ENTER THE FLATS

in this method by turning the burnishing roll by hand. It will be found that the wire on the coils laid about five inches apart receive very little resistance from the wire on the flats.

On the other hand, when the burnishing roll is covered with fillet throughout its length, the burnisher receives much more resistance from the flats, which causes the teeth of the flats to lose their point. Another advantage of covering the burnisher roll

with coils of fillet five inches apart, is that it can be set deeper, and besides burnishing the wire, it serves as a flat cleaner—try it. Set it so the burnishing wire will just touch the cloth or foundation of the wire. When the burnishing roll is covered with fillet throughout its length, set it no deeper than one-eighth of an inch into the wire on the flats. One point which should be kept in mind with the use of the Horsfall wheel is the tendency to grind down the sides of the cylinder and doffer rather more than the centre. When setting the flats and doffer, this should be remembered, and the setting gauge should be passed at the centre of the doffer and cylinder to be sure that there is no contact.

Another point is to not oil the grinding wheels while in operation. The grinding wheels

SHOULD BE OILED

before they are placed on the card, and the oil worked into the parts oiled, so that the wheels will not throw drops of oil on the cylinder and doffer, which will cause much bad work. When the wheels throw oil on the cylinder or doffer, the oil escapes from the cylinder and doffer, and owing to their high surface velocity, oil is carried onto the screens, which afterwards collects dirt to such an extent that the wire surface of the cylinder is touched, which shows in the form of holes in the web. This is a trouble that is sometimes hard to locate. All carders know the point the writer gives here is nothing short of a nuisance to have fly or other foreign matter touching the doffer and forming a streak of holes in the web. It only takes a visit to some of our print cloth mills to see such existing conditions.

There are several methods of cleaning the flats. One good method is to use a wooden roll with the burnishing coils of fillet placed five inches apart spirally, and run at a high rate of speed. This high speed can be obtained by placing a small groove pulley on the end of the burnishing roll. An extra band should be used to run the flat stripping brush at a high velocity and in the opposite direction. This can be done by having a band long enough to circle the pulley on the cylinder, which is used for speeding the doffer when grinding, and to also circle the groove pulley on the end of the flat stripping brush. When the flat stripping brush is made to revolve at such a

HIGH VELOCITY,

and in the opposite direction, it loosens the short fibres and dirt that are lodged at the foundation of the flats when the flats are at their turning point, which are afterwards completely removed from the flat by the spiral burnishing brush. The second method and best method is to drive the flat stripping brush the same as in the first method; but instead of having burnishing fillet on the wooden roll, a new patented wire is used instead. which gives better results.

The knee of the wire of this new patented fillet is almost at the top of the wire, which forms something like a hook, but not bent to that extent. This brush just described will clean a dirty set of flats in 90 minutes. If the flats are not very dirty, once around is sufficient, which is about 45 to 46 minutes. We hear much talk of late about a new device, called a fancy, that is placed between the flats and doffer in the front of the card. This late device is much misunderstood, and let me say right here that it is useless if the card is covered with proper clothing. The claim of this late device is that it will keep the cylinder from being charged with leaves and dirt, and it will also make the yarn stronger.

Now, in the first place, all good carders know the cause of the cylinder filling up with seeds, leaves and dirt, the cause being the wrong number of wire on the cylinder. When dirty stock to make coarse yarn is run on a card, the cylinder should be covered with coarse wire, in order to prevent the cylinder from holding this foreign matter until the

CYLINDER IS CHARGED

with dirt and not able to give the fibres under its action a proper combing. The necessity of having an at-

tachment on a card to keep the cylinder clean and make the yarn strong, is the same as many mill men are doing to-day in the picker-room. They get the air-current out of order, and when split laps are made, they buy a split lap preventer.

Of course, using a fancy on a cylinder covered with fine wire will keep the seeds and leaves from lodging in the cylinder wire for any length of time, the same as you can buy a split lap preventer when your air-current is wrong. As regards the second claim, the up-to-date mill man knows that temperature and humidity have much effect upon the tensile strength of the cotton fibres, and the only device at the present time that will help the cotton to retain its tensile strength during manufacturing, is a humidifier. Any mill man should know that any device that will give the fibres a combing will injure them. The object of the fancy, as stated above, is to remove all seeds and neps from the cylinder when running card strippings, or sweeping and fly. The mill men must not be mislead by such claims and waste money, unless the card is made to run card strippings or waste for a certain length of time. When using this so-called fancy, care should be taken in not setting too close to the foundation of the fillet, because it is covered with ordinary stripping fillet, and revolves at a high rate of speed. A good rule for setting this new device is to set it so that it will remove the stock on the points of the cylinder wire to show a space of one inch when the fancy is removed from the card. No. 30.

XXXI. CARD CLOTHING.

We hear carders often remark about which builder makes the best card, but never a word about the card clother. It is the card clothing that does the work. All cards are built about alike. They all consist of a cylinder and doffer, covered with clothing, which act upon the fibres. So it is the clothing that should be considered, and not the make of the card. We have explained elsewhere the benefit received from plough ground wire, and also how to judge the best wire, but the foundation should be considered also. The character of the foundation of any clothing goes a long way in obtaining proper settings, because, if the teeth of the wire are not held with considerable firmness, and not allowed a certain freedom of motion, the best results in carding cannot be obtained. If the card clothing consists of only cotton, the foundation of the wire will be firm, but when the wire is knocked back by a large tuft of cotton, or by some material of too hard a nature, the wire, when acted upon by the wire knife, will not respond to its stroke, thus remaining in its injured form. On the other hand, if the foundation consists of cotton and woolen, the foundation will be as firm as when all cotton, and at the same time allow a certain freedom; and when the wires are knocked back, they are easily brought to their former position with the wire knife.

Fillet, composed of all cotton, will also stretch and remain in this form, causing high places here and there on the cylinder, termed blistered. This trouble is noticed more when the cards are on the bottom floor of the mill, because there is always a certain amount of dampness, which causes the fillet to stretch. When the fillet consists of cotton and woolen yarns, it possesses a certain elasticity, and when the dampness does affect the clothing, the tension on each coil of fillet is returned by the dry weather. However, we would advise when a mill is not in operation for any length of time, say, over a week, all the card cylinders should be turned a little, so as to expose other parts of the clothing to the openings of the card, to avoid the possibility of blistering the cylinder.

BLISTERED CLOTHING.

Card clothing will blister, whether it is composed of all cotton or mixed with woolen, the only difference being, as stated above, that the cotton and woolen fillet will return to its former position. So, when a cylinder is blistered after a long shut-down, and the clothing is composed of cotton and woolen, the best remedy is

to raise the flats for a day or two, or, until the blisters disappear, when the flats can be returned to their former position. Now, the reader should understand that to do this would be impossible, if the flats had to be removed to do the setting.

There is a certain card which has an index nut that indicates the amount the flats are raised or lowered. Each divison on the index nut represents 1-1,000 part of an inch, and when the index nut is turned to the extent of one division, it must be understood that the flats are moved nearer or away 1-1,000 part of an inch. It can be seen that such an arrangement is valuable, because the flats can all be altred in a short time, and operation made possible. Of course, many readers working in a climate that is not very changeable will not agree with the writer, but there are other readers I know, who have experienced blistered cylinders after a long shut-down; and they have had to remove the flats in order to get a proper setting. A good rule to determine whether the fillet is composed of all cotton, is to boil a piece of the clothing for ten minutes in a 5 per cent solution of caustic soda. If wool is present it will all dissolve, and the fillet will have a ragged foundation.

FILLET FOUNDATION.

The foundation is generally woven three or four-ply, but the four-ply is better, because two-ply woolen fabric can be inserted between the two cotton fabrics, the latter imparting the requisite strength, and the former giving a firm but elastic grip on the teeth, and also retaining the qualities explained above. There is some fillet coated with a veneer of India rubber, but it has given so much trouble that it is used very little at the present time, if at all. The chief defect of a fillet coated with a veneer of India rubber, is that its deterioration is great in a hot room, or when subjected to the direct rays of the sun; and in most cases it has been found that its foundation was spoiled before the wire was appreciably worn. No. 31.

XXXII. DOFFER COMB AND COMB BOX.

A book could be written about card clothing, giving the different angles of the wire, etc.; but, as we have stated before, our aim is to give the reader something new, if possible, and not have him spend his time reading matter that appears so often. We have explained elsewhere what kind of clothing is best to cover a card, and we have also pointed out the importance of considering the temper of the wire. Many readers will say, that, to know the temper of the wire is an impossibility, because most carders will tell you that a man cannot be a good judge of cotton and a good judge of the tempering of steel.

TEMPER OF WIRE.

It is not necessary for a carder to examine the wire of a card to know the temper of the wire when it has been in operation and ground a number of times, because the doffer having the highest tempered wire will cause the web to sag. Most carders may not have given this matter any consideration, but let me ask why it is that, with exactly the same gearing on a card, the same position of the doffer comb cannot be maintained? We find in most mills doffer combs set high on some cards, and on other cards set low. What is the reason?

The reason is, as we have stated elsewhere, that some cards need grinding every two weeks, while others need grinding every two months; and it will always be found that the card clothing that causes the least sagging of the web, is the very clothing that requires the least grinding to obtain a sharp point on the teeth.

It should be seen from the above that when the wire is very hard, it will hold the sharp edge, and of course, will not require grinding as often as a wire that is softer. Again, it should be seen that when a card is ground often, the wire is shortened each time, which disturbs the settings of the different parts of the card, besides reducing the diameter of the doffer, which causes the web to be stretched in all cases when the wire is soft. So, the only

remedy is to regulate the tension of the web by raising or lowering the doffer comb. Sometimes it becomes necessary to change the gear on the end of the large calender roll shaft. When this has to be done, the card sliver should be weighed before and after the change; and if it is found that the change is too great, and making the sliver too heavy, the doffer should be recovered, and the gearing on the card made the same as on all cards.

COMB BOXES.

One point that should be considered on the different makes of cards is the comb box, which gives more trouble than any other part of the card, if the parts of which it consists are not adjustable. Most all comb boxes consist of an eccentric revolving inside of fork-shaped arms which impart vibration to the comb. If the forks or arms can be adjusted, so as to hug the eccentric at all times, no trouble will result, but if those parts cannot be adjusted, and are not made to hug the eccentric, much trouble and expense is the result. The doffer comb eccentric revolves at a very high velocity, and if any play exists between the eccentric and arms, a second vibration is thus created, which in time will loosen the comb posts that hold the blade of the comb, with the result that the doffer comb is allowed to come in contact with the wire on the doffer, thus injuring the wire on the doffer, and also the teeth of the comb. Now, all experienced carders know the trouble a comb in such a condition will give, and that it takes hours of patient use of pumice stone to smooth the injured places. On the other hand, if the arms are adjustable, and can be made to hug the eccentric at all times, a second vibration never exists, and the doffer comb is found always in good condition.

A MONEY SAVER.

Of late, many mills have changed their comb boxes, and a superintendent, having made the change, told the writer that the adjustable comb box not only saves the comb, but also the oil, to such an amount as to pay for the change in the period of one year. The second vibration is the cause of the oil escaping from the box, because when the arms and eccentric are continually coming together at such a high rate of speed, a spray of oil is caused to exist at all times, which escapes through the oil hole at the top of the box, and also around the opening for the reception of the comb. No. 32.

XXXIII. STRIPPING.

The setting of the stripping roll is important, and should be set so its teeth will project a slight distance into the wire of the cylinder, usually 3-16 of an inch. The number of times that a card should be stripped depends on the weight of the cotton that is put through the card per day; but in print cloth mills, the stripping is usually done in the morning and afternoon. One point we wish to give here, that will make it possible for some mills to have evener numbers of yarn, is to strip the cards in intervals. What we wish to convey, is that if there are six rows of cards in a room, one row should be stripped every hour. Few overseers give the variations of the sliver before and after stripping very little consideration, and the writer offers the following figures to show such variations which are the cause of much uneven yarn.

Number of the cards: 1-2-3-4-5-6-7-8-9-10. Weight of the card sliver, befor stripping: 50-51-54-51-50-50-53-51-50-51 grains; after stripping, 45-45-44-45-46-45-46-44-47-45 grains.

It can be seen from the above that there is much variation in the card sliver and that by stripping each row every hour, a much evener yarn is obtained.

VARIABLE SLIVER.

When the cards are all stripped at one time, as is usually the case in most all mills, all the work coming from the cards is light, and put up at the back of the first process of drawing at the same time, thus causing a heavy and light sliver. On the other hand, if the cards are stripped in intervals, as explained above, there

is always a heavy end running with a light end, and the production of an even sliver is assured. In stripping cards two men are usually employed, and one of the two should be the leader, and should have the stripper belt side of the card; and should be payed a little more and the responsibilty of the cards being stripped properly, and at the right time, should be placed on him. One important point about stripping is to allow the strippers to stop at least four cards ahead of the card being stripped.

When strippers are allowed to stop only two cards ahead of the one being stripped, the cylinder is not at a standstill when the card is recahed to be stripped. This has been the cause of many accidents in many card rooms. The way such accidents are caused is in most cases through carelessness, but, nevertheless, if the strippers are allowed to stop more cards, such accidents can be prevented.

If this stopping of so many cards cannot be done on account of the shortage in production, then the only thing to do, is to install more cards, because one accident may cost the plant more than the price of a dozen cards.

The way such accidents happen, is by one stripper shifting the belt from the tight pulley to the loose pulley, and at the same time pulling down the stripping door. When only two cards are stopped and a card is reached with the card cylinder still revolving, and as stated above, the stripping door was pulled down at the time of shifting the belt from the tight pulley to the loose pulley by the first stripper, imagine what happens when the second stripper reaches the card and knowing nothing about the door being pulled down by the first stripper, instead of looking he puts his hand at the point where the stripping door is opened, and at the same time, having the stripping roll in the other hand, which is taking up his mind at that moment, the result is that he loses a finger or more, perhaps, an arm. No. 33.

XXXIV. MANAGEMENT OF CARDS.

In the management of cards many points should be watched, which will save the plant many dollars. The chief point is the production of good work, which is obtained by keeping the licker-in in good condition so that no neps will be caused at this point, and the cylinder flats and doffer wire property ground.

The second point is to watch the settings of the cards and have every part set so as to save your employer a lot of good staple, or to set so that the heavy impurities and short fibres will drop so as not to injure the quality of the cloth. The third point is to turn off as large a production as is consistent with the quality of the work required. The fourth is to try and have all the webs appear the same; that is, not to have the web of one card appear as if the calender rolls are pulling the web from the comb and the next card having the appearance of sagging at all times. The fifth is to see that the fly is clean from under the card as required and also the strips. The sixth is to see that the cylinder bearings are properly filled with good tallow, and the comb box and other parts of the card are filled with oil. Seventh, see that the grinding wheels and dead rolls are placed in the rack, because when they are left on the card when not grinding, there is always danger of their being knocked off the card, with the result of much injury to the different parts of the card. The grinding rolls, when knocked off the card, will, in most cases, break the bearing of the opposite end, from which the roll is knocked off, and many times even the arch of the card is broken.

CARDER'S METHOD.

The carder, when making his rounds, should withdraw a portion of the web every day from every card running, and hold it to the light, then he can see the foreign matter remaining in the web. From the grade of stock running through, and the speed of the card and also the weight of the sliver being run, the overseer should be able to form an

opinion whether it is the conditions under which the cards are run or whether the grinder is at fault when the web has a poor appearance.

The carder should also sample the stripping and fly every day to see if long staple cotton is escaping the action of the card.

The weight of a card sliver to make 28s yarn should not exceed 50 grains to the yard. A good speed for American cotton when intended for 28s yarn, carding 700 to 800 pounds per week, is about 12 turns per minute of a 27-inch doffer.

The speeds for a coarser yarn and the speeds for finer yarns will be given later.

After the carder has examined every web, and he has given the grinder instructions how to remedy some of the webs having a bad appearance, he should then examine all the flats on every card, and if a streak is noticed, as we have explained elsewhere, the card should be immediately stopped, and the cylinder examined.

To find the production of a card, first find the constant, by multiplying the circumference of the doffer by the minutes run, and divide by 36 inches, and 840.

EXAMPLE.

Minutes run....................................3480
Diameter doffer.................................. 27

27x3.1416 = 84.8232 in.
84.8232x3480 = 295184.7360
295184.7360 divided by 36 = 8199.51 divided by 840 equals 9.761 constant.

To use the constant: Divide the weight of the sliver in grains into the constant for one yard, which is 8.33. This will give the hank carding. Divide the hank carding into constant, and multiply by the revolutions of the doffer per minute, and the result will be the production 100 per cent weight of sliver, 52 grains.

EXAMPLE.

8.33 divided by 52 = .160 hank carding

9.761 divided by .160 equals 61x13 Rev. doffer equals 793 pounds.

In summing up, it should be remembered that work spoiled on a card cannot be remedied in after processes, and that the basis for strong or weak yarn is laid in the carding. No. 34.

XXXV. RAILWAY HEADS.

In a print cloth mill the cleaning of the fibre from impurities ends with the card. In a fine goods mill the cleaning of the fibre ends at the comber.

In some print cloth mills railway heads are employed with the modern revolving flat card, taking up the slivers from the card cans, instead of from the old card apron in the railway.

The chief criticism that can be made on all railway heads, is that it does not act on the stock it is supposed to correct, until at least a part of the faulty stock has passed beyond its evening action. This is the chief cause and reason why they are fast passing their usefulness as an evening agent.

Many articles appear from time to time in various textile papers condemning all types of railway heads, which makes very discouraging reading for the manufacturers who have lately installed the latest type.

Some manufacturers have discarded the latest type of railway heads, and instead have installed another process of drawing, because they were convinced by such articles that the railway heads did pass faulty stock. The writer is willing to admit that the railway head does allow faulty stock to pass its

EVENING ACTION,

but would not advise manufacturers to discard the new type of railway heads, as was lately done by many manufacturers.

Such mistakes are often pointed out in the columns of the American Wool and Cotton Reporter, and the following advice is given for the manufacturers that are planning to install another process of drawing instead of the railway heads now in use.

The manufacturers need not be told that the drawing rolls of the railway heads are the same as the drawing rolls on the drawings, and will do the same work.

Now, instead of discarding the railway head complete, just discard the cones and friction ring.

This can be done at a very small expense, and when the change is done you have the same drawing operation on your four lines of drawing rolls, as on the drawing frame. Again it is possible to arrange the heads, from one upwards, and they can be embodied in one continuous frame. Figure 5 shows a gearing diagram of the latest type of railway head with the evening motion. Now by disconnecting the evener cones A and A1, shown in the upper right-hand corner of Figure 5, and connecting the two shafts by suitable gearing, the delivery becomes the same as with a drawing frame. It should be seen from the above that a great deal of money is wasted when the railway heads are discarded, and

ANOTHER PROCESS

of drawing installed, when as pointed out, the railway heads can be embodied together so as to form a drawing. The change can easily be made and at a very small cost.

The reader can plainly see that all manufacturers that have discarded the latest type of railway heads, and installed another process of drawing, have made a costly mistake, because the change pointed out is the only one necessary.

Some manufacturers allow their carders to remove the pawls and run the friction ring in one position, or

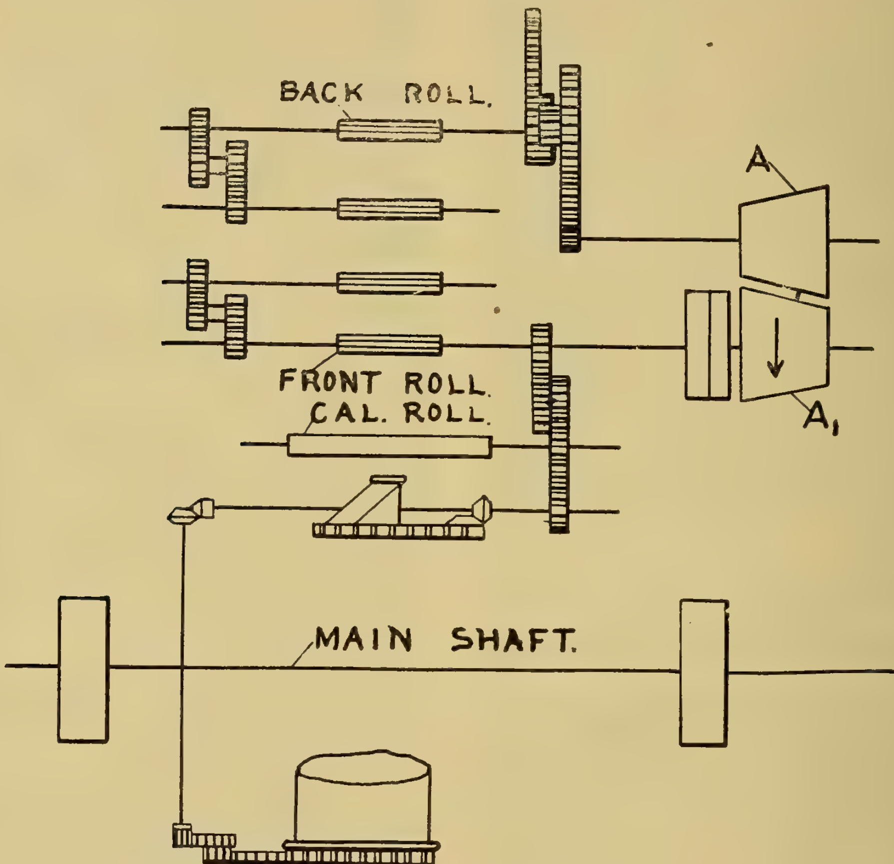


Figure 5, Railway Head Gearing Diagram.

on the older type of railway heads, the large worm that moves the shipper back and forth is also prevented from operating by removing the pawls.

Both of the above methods are wrong, because there is always friction between the two cones, one the latest type railway head, and also friction on the old railway head caused by the bottom cone driving the top cone by means of a small belt. When leather rolls are used there is always a little friction and the draft is not positive. So it can be seen that if the railway heads are used as described above, there is a variation in the break draft of each type of railway heads, and the friction from the break draft and the

FRICTION

on the drawing rolls (when common drawing rolls are used) added together will cause faulty stock to pass the railway head, as when using the evener motion. It is wrong to run railway heads with evener motion, because it causes more heavy and light places in the strand delivered than when without the evener motion.

It should be understood that if a heavy place in the strand is so large as to bring the trumpet forward, the part of the sliver having brought the trumpet forward is passed beyond the action of the evener motion, and if this heavy place is only short, it will cause a short length of light work to come through, because as soon as a part of a heavy sliver passes the trumpet, its forward movement uncovers a certain number of teeth which are acted upon by a pawl, and the drawing rolls are made to draw more, thus making a light place; that is, if the length of faulty stock is not great. On the other hand, if the faulty stock is of a considerable length, the latter part of the sliver will be remedied somewhat.

No. 35.

XXXVI. DRAWING.

When railway heads are altered and its delivery made to operate as the delivery of a drawing frame, we advise to run only six ends up at the back, as on the drawing frames. The large draft that is made to exist on railway heads is mostly the cause of the latter producing weak yarn. It is often seen that a railway head has a draft of 8 to 10 inches.

Still the very men that would have such a large draft on a railway head, would not have the drafts in after processes to exceed seven. It should be understood that a

LARGE DRAFT

on a railway head is as injurious to the fibres as a large draft on a fine frame.

Very few overseers give this long drafting much consideration. Picture in your mind eight drawing slivers passing under the drawing action of four lines of drawing rolls to the trumpet. Think of the bulk of stock that the front roll is called on to pull away from the bite of the second roll.

Again, think of the strain that is caused on most fibres that are held together, owing to the pressure from the top roll, and think what happens if the fibres are not quickly released. It should be seen that when such a length of strand is made from one inch of a collection of strands, that many fibres are broken, because a railway head, besides having a large draft, its front roll revolves at a high rate of speed.

Roll drafting is no doubt the most important feature of parallelizing and attenuating in the production of good yarn. There are two kinds of drawing rolls, the leather covered roll, which is known as a common roll, and the metallic roll, constructed of steel. Grooves are cut lengthwise in the surface of the boss of the rolls at certain intervals, which determine the pitch of the rolls.

The common rolls are driven by frictional contact from the bottom steel rolls, while those that are metallic are driven by the flutes of the lower roll meshing with the flutes of the upper roll, and consequently a more positive draft is obtained than with the common rolls.

Many carders conceive the idea that because the

DRAFT IS POSITIVE

with metallic rolls, that a longer draft can be obtained without friction. Although a long draft will cause no friction when using metallic rolls, it must be remembered that a long draft will injure the fibres, as was explained.

There is much argument about the metallic rolls and their merit. Therefore, the construction of metallic rolls and various points pertaining to them justifies a detailed description. As stated, they are usually constructed of steel, and are fluted at certain intervals—the groove being a little less in width at the bottom than at the top, and the number of flutes on the boss for the various rolls increases with the circumference of the bosses, and the weight of sliver it acts upon. A, A1 Figure 6, are the fluted portion of the rolls and B, B1, the collars. Figure 7 is a cross-section of the rolls described in Figure 6. The back rolls contain 16 flutes on their circumference for each inch of diameter. The third roll, 24 flutes, and the front and second rolls have 32 flutes. When a roll contains 24 flutes on its circumference for each inch of diameter, it is known as a 24-pitch roll, therefore, the number of flutes on the boss of the rolls determines the pitch. When a metallic roll has only 16 flutes on its circumference for each inch of diameter, the overlap is made greater, because it acts upon the bulky sliver presented to its action, and it should be seen that the 32-pitch roll requires

LESS OVERLAP

than the 16-pitch roll. So in order to suit each pitch, the diameter of the collars on a 16-pitch roll is .07 inch less than the diameter of the boss or fluted section, and as both rolls are the same, the amount of overlap is .07 inch. On a 24-pitch roll the collars are .06 inch less in diameter than the boss, and on a 32-pitch roll they are .044 inch less than the boss.

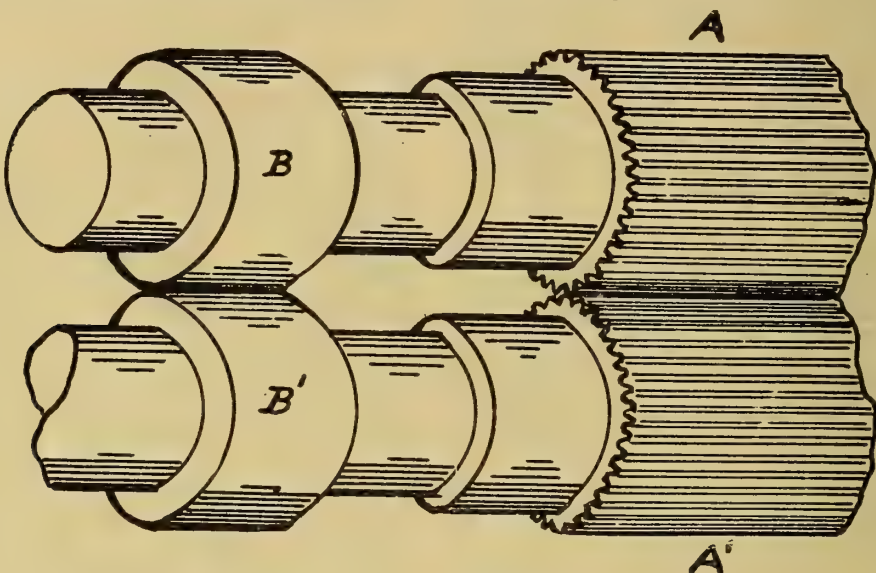


Figure 6, Metallic Drawing-Rolls.

It can be seen from the above that the collars prevent the rolls from coming into too close contact, and that the amount of overlap sufficient to grip the sliver is obtained by having the collars the proper diameter. By referring to Figure 7, it can be seen that the sliver does not follow a straight line, and is crimped, which is caused by the overlap. Again by referring to Figures 6 and 7, it can

be seen that the collars keep the rolls separated, and that it is impossible for the flutes to bottom and injure the staple. No. 36.

XXXVII. METALLIC ROLLS.

The operation of the flutes of the metallic rolls is the same as the teeth of two gears meshing together, and it should be seen that the grip upon the staple of the sliver is caused by the flutes of the bottom roll meshing and imparting power to the top rolls. The resistance that the top rolls offer to the meshing of the bottom rolls, creates a grip on the side of the flutes in contact,

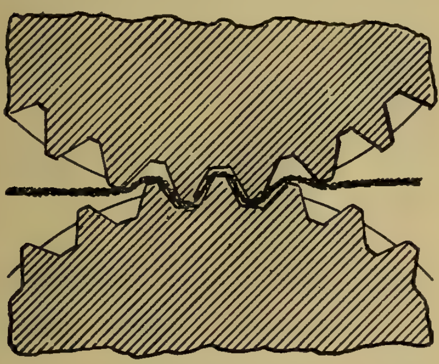


Figure 7.
Cross Section of Metallic Rolls.

so that the fibres are pulled from the back roll without injury. Thus it can be seen that the bite or grip of the flutes is not at the bottom of the flutes but on the side. Again, by referring to Figure 7, (in our issue of October 13) it should be seen that the bite or

GRIP OF THE ROLL

itself comes on the side of the roll, instead of in the centre, as on common leathered-covered rolls, and that the distance from centre to centre should be greater on metallic rolls than on common rolls.

A great mistake is made in the weighting of metallic rolls in most mills—even in textile schools.

The metallic roll company advises to weight every roll with 14-pound weights, but such weighting has given very poor results.

When a 16-pitch roll is weighted with 14-pound weights, it will be found, when running heavy work, that the surface speed of the dead and preventer rolls (on Howard and Bullough drawings), is greater than the surface speed of the back rolls, owing to the resistance offered to the weighting of the top rolls by a bulky sliver, with the result that the slivers between the preventer rolls and back rolls are continually slack and that causes the slivers to run out at the sides of the rolls, which causes a great amount of lapping. It should be seen that the slackness between the preventer and back rolls is caused by the sliver being too bulky, thus separating the collars and reducing the necessary overlap. Weigh your back rolls with 20-pound weights, and the slivers between the preventer and back rolls will follow a straight line. It should be seen that a heavy weight will not

INJURE THE STOCK

and at the same time keep the collars on the back rolls in contact as they should be. The only point that can be offered against using a heavy weight on the back rolls is that it makes the consumption of power greater to run the frame. The back roll of each pair of rolls when using metallic rolls should be greater than the front roll, because the front roll only detaches the free fibres, while all back rolls must grip the fibres and not allow them to escape in bulk, but gradually. So on the third roll we place 16-pound weights, and on the second roll, 14-pound weights, and on the front roll 12-pound weights.

The setting of metallic rolls is much misunderstood, and it is the chief cause of their failure. In setting metallic rolls, there is one broad principle that must always be followed, as on all other rolls; that is, the distance between the bite of each pair of rolls must always exceed the average length of the staple being used, and that high speeded rolls require wider settings than those having a slower speed. When setting metallic and other rolls, the first thing to do, is to sample the staple to find its

average length. For one-inch American cotton running a 60-grain sliver (6 into 1), the distance between the first and second roll,

CENTRE TO CENTRE,

should be (for metallic rolls), 1½ inches. This will make the distance from the bite of the first and second roll, which is the proper one, 1¼ inches.

As stated, many carders conceived the idea that the bite of the rolls is at the bottom of the centre flute, so they have the same distance between metallic rolls as on leather-covered rolls, thus producing a stringy web and injuring the fibres, which is the cause of many mills having had to sell them for junk.

Metallic rolls are all right if they are given proper care, but, like other rolls, if they are neglected, they also give trouble. The writer has many times heard the remark, that the only fault that could be found with the metallic rolls, was that they would run without oiling, and in a short time, all the journals for the reception of the roller ends become worn—even the roller ends.

No. 37.

XXXVIII. CARE OF ROLLS.

The above is a wrong idea of metallic rolls, because, as stated, metallic rolls will give trouble when dry —why they will even give trouble when the end of the roll fits tight in the journal. The above statement is proved by swapping the rolls here and there when they sag. When metallic rolls are dry from the want of oil, the sliver webs are sagging here and there, so that they require

PROPER CARE

as regards oiling and cleaning.

They should be scoured at least every three weeks, and the flutes should be cleaned with coarse sawdust. Some overseers allow metallic rolls to be cleaned with a piece of card fillet, but it is wrong to do the scouring that way. Coarse sawdust will not injure the flutes of the rolls, but will clean the rolls without scratching the flutes.

As stated, the metallic rolls require proper care to get from them the advantages claimed.

The chief advantage of the metallic rolls is that the top rolls are positively driven by the flutes of the lower roll meshing with the flutes of the upper roll, and thus a positive draft is obtained.

The above advantage of the metallic roll over the leather-covered rolls is what most inventors must have had in mind for many years, because, as stated in the columns of the American Wool and Cotton Reporter, the friction on all leather-covered rolls is great.

The setting of the third roll from the second roll is not as important as the setting of the second roll from the first. However, when the distance between the first and second rolls is 1½ inches, the distance between the second and third rolls should be 1⅝ inches, and between the third and fourth, 1¾ inches. When a longer cotton is used, make

THE SETTINGS

between the rolls correspondingly wider.

Some overseers claim that the heavy weights on all kinds of rolls should be on the front rolls, in order to keep them more steady.

When a top roll jumps, whether it is a common or a metallic roll, putting on a heavier weight is not the proper remedy, because it should be seen that if a roll is not properly covered or out of true, the same vibration will exist with a heavier weight. The proper thing to do is to suspend the weights on springs or very strong banding, which will serve as a cushion, thus eliminating the vibration.

When banding is used it should be replaced every two months, because in that time, it has lost its elasticity.

Leather-covered rolls need no description as they are understood by all mill men, but one point we wish to give here, is that when a new roll is placed on a frame, care should be taken that the little mark on the roll should be between the person placing the roll and the roller lap. This

saves the lap of the roll, because, when placed in this way, the roll runs in the same direction as the lap, instead of against the lap as occurs when placed otherwise.

Another point that will save the leather rolls when oiling, is to be careful and not get any oil on the leather.

When running leather covered rolls on any kind of machines, the same attention should be given to the bottom steel roll as when running metalic rolls. One mistake we wish to point out, which exists in many mills to-day is in having too much weight on the top leather-covered rolls. Of late, machine builders have increased the number of flutes from 49 to 53 on a one-inch diameter front roll. The idea is all right, only as stated, the pressure upon such a constructed roll should not be as great. When the number of flutes are increased, the flutes are not so wedge-shaped, and they have a better grip on the fibres, thus their drawing qualities are increased.

On the other hand, it must be remembered that the flute end has more of a knife edge, and the distance between the flutes is increased. It should be seen that when the flutes are spaced as described above, if the pressure of the top roll is not somewhat releaved, the cutting of the flutes into the top roll will occur. The flutes unevenly spaced, or the leather-covered rolls made of different diameters, will prevent, to some extent, the top leather roll from grooving, but, as stated, the only remedy is to have less weight on the top rolls. This can easily be done in most mills, (especially on the ring spinning frames) by moving the weight on the lever a notch or more towards its fulcrum. Many mills are running bottom steel rolls at the present time that should be refluted.

No. 38.

XXXIX. ACTION OF ROLLS.

Mill men need not be told that the constant aciton of the front roll gripping and pulling or detaching the fibres from the second roll, will wear the flutes very smooth on the side that first grips the cotton, and make the side of the flutes following very sharp. To prove the above statement, examine your front rolls if they have been running for over ten years without refluting, use a magnifying glass and it will be found as stated above. When the flutes of a bottom steel roll are worn enough to cause the back side of the flutes to have a knife edge, the least friction on the top roll will be sufficient to cause what may be termed a scraping of the grain of the leather, thus injuring the leather covering to such an extent as to require recovering after only running a short time. Again, when the flutes of the bottom rolls are worn, if the leather covering is not completely destroyed, it will be made so rough that the top roll will be continually taking the strand to the top clearer when an end breaks instead of it being lapped around the lap-stick in the spinning room, as is the case when the covering of the top leather roll is smooth.

The above defect has been the cause of many spinners and superintendents advocating a heavier clearer in the ring spinning room in order to stop the strand of cotton from lapping around the top leather roll. It should be seen that it is a step in the wrong direction to increase the weight of the clearer board, because the more weight upon the front leather roll the

MORE FRICTION

is caused.

There is much argument regarding the merits of the ball-bearing top rolls. The makers claim that they run with a smaller amount of oil, requiring oiling only twice a year; thus the danger of the oil damaging the yarn is not so great. They also claim that owing to the easy running of the shell on the harbor caused by the aid received from the balls revolving with the shell, that only one-half the weight is required in comparison with other top rolls, thus saving wear of the leather and fluted rolls. It is also claimed that they run more steady and produce evener and stronger yarn. The writer is willing to admit that the above claims are

just, if the rolls are given proper care. Again we would recommend such rolls where a mill is forced to have excessive draft, which is the cause of much friction; such rolls will run more steady than a solid roll, but it must be remembered that the injury of an excessive draft with these rolls is just as injurious to the fibres as the solid rolls. On the other hand, it is much more trouble to oil such rolls, and as the machinery must be stopped while oiling, that much production is lost. Again rolls that are oiled only twice a year are sometimes forgotten, with the result that much wearing of the rolls and friction is caused. It should be seen that when ball-bearing rolls are neglected, one side of the shell may

WEAR UNEVEN

which will cause one side of the roll to draw more than the other, thus causing uneven yarn.

The pressure of the top roll on the bottom roll is maintained in most cases by means of weights, and is so well understood by most mill men that only a brief description is necessary. The system of weighting differs, one class is self-weighting and the others dead weighting, and lever weighting. Self-weighting is in having the top roll heavy enough to maintain the necessary pressure on the fibre.

Dead weighting means the weight being suspended on the end of a hook, its line of force not being disturbed. Lever weighting means that a lever carrying a weight is fulcrumed at a certain point on the lever.

We give here the following example which is the only one employed in a cotton mill for practical purposes:

Rule. Multiply the length of the lever from the fulcrum point to the point where the weight hangs on the lever by the weight of the weight on the lever. Divide by the distance of the fulcrum point to the point on the lever connecting the saddle and ...

EXAMPLE.

Length of lever..............................8 inches
Weight of weight..............................5 pounds
Length of fulcrum point and point on lever connected to saddle..................1 inch

$\frac{5 \times 8}{1}$ = 40 lbs. total weight on all rolls under the saddle.

As a rule, it is very seldom that the weighting of the rolls is changed. Sometimes

ATTENTION IS CALLED

to this matter by the top rolls fluting, but in most cases the fluting of rolls is caused by having the top leather covered roll the same diameter as the bottom steel roll. When the diameter of the top roll is the same as the bottom steel roll, the flutes of the bottom steel roll strike the top roll in exactly the same place that they struck previously, thus grooving the top roll.

No. 39.

XL. CHANGING ROLLS.

When the top leather rolls are grooved, the strand delivered is somewhat crimped and of a greater length, which makes the work light and causes it to run badly. Another cause for the top rolls fluting is in not putting the front roll on the second or third roll when a new roll is put in a frame. Taking a top roll off the back roll to put a new roll in its place is very expensive; besides the front roll will groove. New top rolls should always be put on the front roll and the older rolls moved back.

Another point that will save top leather rolls is to have a proper traverse on the boss of the rolls—the longer the better. It should be seen that if there is only one inch traverse on a top roll, the leather covering is doing twice as much work as a roll having a traverse of two inches. So let it be your aim to keep the traverse on all rolls as long as possible in order to keep the roll bill down. The watching of

TRAVERSE MOTIONS

on top rolls is more important than many mill men believe and too little attention as a rule is given to them.

When traverse motions are properly set, they remain so for many years, but in the majority of cases they are not set right in the first place. Reader, if you are an overseer or second hand having charge of traverse motions, you would not like to have some person point out this defect; that is, in not having the traverse on the top roll as long as possible. Again, you would not want to have a person find the traverse stopped and a channel formed at the point where the strand is delivered. Think of the harm that such carelessness will do.

In the first place, many rolls will have to be replaced, and in the second place when the traverse motion is set in operation again, this sudden change in the drawing of the strand will cause many ends to be broken. When a traverse motion that has been stopped long enough to form a channel in the top rolls, is set in operation again, it should be seen that when the strand is acted upon by the perfect parts of hte top roll, the fibres are drawn from the second roll regularly, but as soon as the strand is acted upon by the point of the top roll that has been channeled, it can be seen that there is very little drawing done upon the strand at this point, with the result that the strand delivered is shortened, which will cause the part of the perfect strand from the bite of the roll to the point where it is wound on the bobbin to break. It can be seen from the above that a little

ATTENTION TO THE TRAVERSE motions will save a lot of roll covering, besides keeping the roll bill down, and has promoted many men.

So, as stated, if the traverse motions are given the proper attention, a better quality of production will be obtained, besides economy in roll leather.

The roll saddles will cause much friction when warm, and they should be examined often. By referring to Figure 1, (Illustration No. 8), which shows the proper saddle that should be used for heavy rolls, it can be seen that a very small portion of the saddle is on the surface of the roll, owing to each side of the bearing point of the saddle having an angular position relatively to the surface of the neck of the roll.

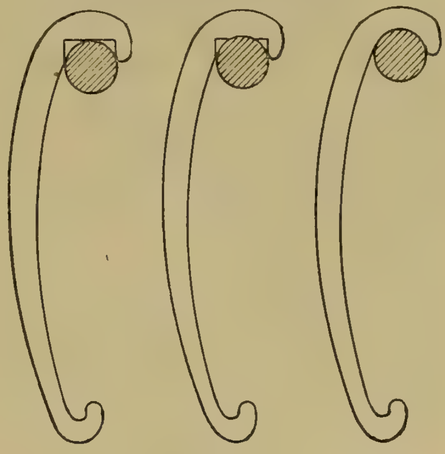


Illustration No. 8.

It can be seen that very little resistance is offered to the top roll when using such a saddle. Figure 2, in Illustration No. 8 shows a worn saddle that should be taken out and filed, so as to bring the bearing point as shown in Figure 1. Figure 3 (Illustration No. 8) shows a saddle that is very much used, but causes more friction than any other saddle. We often mention the evil that friction on the top roll will cause, and we all know that the friction from running a heavy sliver or neglecting to care for the top rolls so that they may revolve freely is the cause of most trouble and uneven yarn throughout a cotton mill. No. 40.

XLI. ROLL COVERING.

One must stop and think and study what friction is, to have an idea how much it will affect a strand of cotton. Friction means the resistance offered the top roll to cause it to lag, thus causing

FRICTIONAL CONTACT between the bottom steel roll and top leather covered roll. When friction exists on a top roll, if the resistance

offered is steady, the sliver will be even but heavy, but it is seldom that any friction is steady, and instead we have an unequal intermittent action on the top roll that makes the strand uneven in places. By again referring to Figure 1 (Illustration No. 8) it should be seen that this is the proper saddle to use in order to eliminate friction.

Figure 2 shows that there is wear on the saddle and will cause more friction than the saddle in Figure 1. Figure 3 causes much friction, especially if the saddle is allowed to become dry from the want of oil.

All mill men know that rollers are neglected in a cotton mill at times, and the greater the amount of working surface occupied by the saddle on the top roll (as shown in Figure 3), the more friction there will be. So it should be seen that the aim should be when weighting top rolls, to have the bearing part of the saddle upon the top roll occupy as little of the working surface of the neck of the top roll as possible.

Another point about leather covered rolls is to always stand them on their ends when not in operation. It is the practice in many mills to allow a box of rolls to stand for days, the rolls laid over the bottom rows. When the rolls are taken from the box, the rolls on the bottom rows have a part of their surface flattened, in some cases to such an extent as to burst the leather covering.

The same can be said when a mill is standing for any length of time, say over four days; if the

PRESSURE IS NOT REMOVED

from the top rolls by unweighting them, or by turning the machine so as to have the pressure bear on another part of the top rolls, the boss of the rolls will be flattened, and if the mill is at a standstill for weeks, the leather covering will burst on many rolls.

A top roll composed of a hard material revolving in contact with the bottom roll would tend to crush the fibres. So every mill man should watch the roll coverer to see that the same size flannel is used at all times, because sometimes roll coverers will only remove the leather and leave the defective flannel on the rolls, which is very injurious to the fibres, because the old flannel is harder, having run a long time under the roll covering. All top rolls must have a yielding quality of cloth and leather in order not to injure the fibres. Again if the cloth and leather covering is uneven in places, the work will be uneven, and if it is the cloth that is uneven and the roll is sent to be covered and the cloth covering is not removed, it should be seen that such rolls are carried back and forth from the roll coverer's shop to the mill continually. The cloth covering should be made of the finest and best of wool, and to ascertain if the cloth covering is made from the best of wool, a good method is to cut the leather covering of old rolls from time to time, and burn the flannel. If the cloth only smothers and

NO FLAMES APPEAR,

this indicates that the cloth is composed of wool fibres, but on the other hand, if the cloth will flame, it shows that a part of the covering consists of cotton.

A good practice in many cotton mills is to have the drawing rolls buffed, that is, to have the surface of the top roll skimmed so as to make the surface even throughout the length of the roll. The above method is a saving to the mill, because drawing roll covering is more expensive than the smaller rolls. Besides a drawing roll after being rebuffed will have an even surface for a longer time than a new roll, but what was said in regard to a hard roll injuring the fibres must be remembered. So all rolls that are rebuffed should always be placed on the two back rows of the drawing frame.

In order to prevent the grain of the leather wearing away and becoming broken, it is the practice in almost every mill to varnish the drawing rolls that perform the heaviest work.

The varnishing of leather rolls is much misunderstood. Text books and textile schools tell us that varnished

rolls should present a smooth, hard surface, but such a statement is erroneous. It is a practice in most all mills to try and have a nice looking roll, that is, to have it look like glass.

A roll in such a condition contains too much glue, which has a tendency to crack, besides when the room contains much moisture, they will keep continually licking up; even if their surface is only touched with the hand, they will lick up. Besides, a drawing roll that has a smooth surface has not so much

DRAWING QUALITIES

as the rolls that are a little rough.

Instead of trying to have a nice looking drawing roll, let it be your aim to have a roll with a drawing quality, that will enable it to do its work and eliminate friction.

The writer has used the following recipe for roll varnish, and if given a trial, it will be found very good if used as we direct. To one quart of acetic acid, use four ounces of fish glue, one teaspoonful of oil origanum; let this mixture stand for at least 48 hours, after which it may be thickened with chrome green powdered paint. It will be found that the above recipe gives the rolls a dull appearance and must be varnished oftener. A good rule to follow when using this varnish is to have many spare rolls on hand. Varnish the back rows every six weeks and the front rows every week. This will not only make the rolls appear in good condition at all times, but they will retain their drawing quality. The varnish should be put on the rolls as evenly as possible, and the best method of doing this, is to have a board a little longer than the drawing rolls, and as wide. Cover this board with woolen cloth, the cloth being

PULLED TIGHTLY

and secured at the edges when level. Then a brush should be used to paint the flannel or woolen cloth the width of the boss of the roll, and then the roll should be moved over the surface of the cloth by placing the palm of each hand on each end of the roll, giving the roll a backward and forward movement, until the varnish is spread evenly over the whole surface of the roll.

A new roll should receive four coats of varnish, but the rolls taken from the drawing frame, should receive only two coats. Some mills even varnish the slubber rolls, and claim that good results are obtained. The American Wool and Cotton Reporter is continually pointing out this error; that is, instead of varnishing your slubber rolls to stop friction on the top rolls when using a heavy drawing sliver, and we must again repeat here, that the fibres are injured by such an excessive draft. So, instead of running a heavy sliver, and varnishing the slubber rolls, besides injuring the fibres, make your finished drawing sliver lighter, thus avoiding unnecessary work, and besides the making of a perfect compact strand. No. 41.

XLII. AFTER CARDING.

After leaving the card, the next preparatory process to which the sliver is subjected depends upon the final use to which the fibre or yarn is intended. For the average kind of yarns, railway heads and drawing usually are the processes following the card, whereas for the better class of yarns (about 65s and above) the process of combing and combing equipment previous to the drawing process is introduced.

Yarn which only passes through the drawing frame process is called carded yarn, while that which goes through the comber is called combed yarn. They are sometimes sub-divided into single carded yarns, or double carded yarns, thus indicating that they have been carded once or twice.

Even yarn depends upon four factors which are practically unattainable by the card alone. (1) The overseer in charge of combers must understand the structure and peculiarities of the fibres in order to sample and examine the stock properly. This is the most important factor, because if the overseer is a poor judge of cotton and does not allow for the amount of natu-

ral twist that exists more in one kind of cotton than another, he is unable to obtain a perfect overlapping which is the basis for strong or weak combed yarn. As stated, if this normal

CURL IN THE FIBRES

is not allowed for when setting and timing, it will be impossible to obtain the best results. (2) The fibres must be arranged individually and in parallel order, a position they must maintain in after processes. If the card web be closely examined, it will be found that the cotton fibre, on account of its natural twist, has a normal

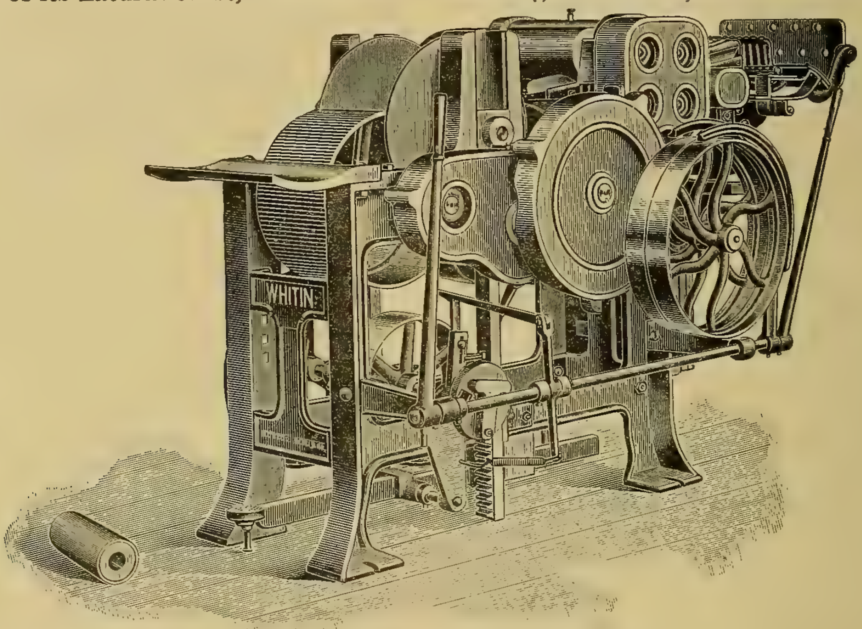


Fig. 9. Sliver Lap Machine.

tendency to curl up, and consequently, readily becomes crossed and tangled during its treatment by the various machines. (3) The fibres composing the yarn must be uniform in length, which is impossible to be obtained with the most perfect card of the present time.

Examining closely a carded sliver will at once convince the observer that large quantities of irregularly stapled cotton exist, which must be eliminated before the higher counts of yarn can be spun. (4) The fibres must be united, so that the individual fibres

only, of course, the length can be eas- composing the sliver will regularly overlap each other in such a way as to give an even appearance to the sliver and also to strengthen it, and in turn afterwards to the roving and yarn. Perfect overlapping of fibres is only obtained by the use of combers. Before explaining the operation of combing, as stated, the overseer must understand the structure and peculiarities of the fibres. Therefore, their construction justifies a detailed explanation. As is well known by most mill men, cotton is a vegetable fibre, and to the naked

eye appears to be about the same, ily determined by sampling. But when examined

UNDER A MICROSCOPE

it does not have that fine, smooth and solid appearance that it had when examined by the naked eye, but instead, each fibre appears to be a collapsed tube, twisted many times throughout its length, which, as stated, affects its actual length. The above can easily be proven when only the drawing processes are employed in a cotton mill. When the cotton is sampled at mixing time, as it should be, and the

staple is found to be 1⅜ inch in length, it will be found almost 1¼ inch at the finished process of drawing. As we have stated to the query pertaining to the proper amount of twist that should be inserted in a certain number of yarn, the convolutions interlock with one another and help to resist any tension necessarily put on the yarn. So it can be seen that, as stated, the construction of the fibres is important when setting and timing a comber, because all fibres are not in the same collapsed form and are not twisted the same, which affects the length of the staple, and also the setting on a comber.

Cotton, like almost everything of vegetable origin, has as its chief constituent cellulose, a substance that is hard to work if heated or dry, also if too moist. It is this substance combined with wax that causes feed plate caking on the cards, as was explained elsewhere. No. 42.

XLIII. SELECTION OF COTTON.

It is the cellulose of which cotton mostly consists that absorbs and retains moisture. Another important point to be considered by manufacturers is the selection of cotton from samples; for instance, in cotton to be used for filling yarns, the color is more important than in cotton warp yarns. If the cotton is tinged, or of a darker color than most of the cotton being used, it should be put into the warp yarn, because if tinged cotton is put into the filling, the cloth will have a tinged colored appearance, because one cop or bobbin of filling yarn will weave in most mills from 17 to 22 inches of cloth, while the warp ends only occupy 1-1,000 or more part of the width of the cloth, sometimes less. Again, the amount of removable foreign matter in cotton varies greatly with the variety, and even in different growths of the same variety.

From the above, it should be seen that in order to operate combers economically the setting and timing of a comber is as important as on a card. But there is one great mistake made in most fine goods mills, and that is not to have the card take out the proper amount of foreign matter it should, and throw more work on the combers, because comber waste is worth more than card waste. The disadvantages to this method are that so much extra work is being put on the combs, which is naturally very injurious to them, besides not allowing as thorough a combing of the fibres as would otherwise occur. The card and combers are each built to do a certain amount of work in the preparatory processes, and should be run accordingly. If the card is favored, and an extra amount of work is thrown on the comber, the result will be that the quality will suffer.

The percentage of short fibres taken out by the comb depends upon the grade of cotton that is used and the fineness of the yarn that is required spun. This amount varies from 10 to 30 per cent. When using long stapled cottons full of impurities it has been found necessary to give this kind of cotton a double combing. Although double combing improves the character of the yarn, it is not much superior to single combing, besides the result is a high-priced yarn, both on account of labor as well as the high price of the raw cotton which has to be used. Again, fibres that are doubly combed are more weakened.

Combing equipment usually includes two machines besides the comber. The first is the sliver lap machine, of which a side view of both sides is given in Figures 9 and 10.

The object of the sliver lap machine is the making of a lap from a number of card slivers. Only a brief description is given here as regards its operation, because what will be said when the drawing frame is explained can be applied here. A sliver lap machine can employ as much as eighteen cans, and at the same time, the draft will not exceed two.

It should be seen that what we have said as regards reducing the number of slivers on the railway head does not hold good here, because when 8 slivers are running in at the back of a rail-

way head, the draft of the machine

MUST BE EXCESSIVE,

while on a sliver lap machine eighteen slivers can be run in at the back and still have a short draft. The reason for this should easily be seen by persons not acquainted with combing equipment, because on a railway head the eight slivers have to be drawn so that the delivered sliver will not exceed the weight per yard of one of the eight slivers running at the back, while on a sliver lap machine the weight per yard of the strand delivered in some cases exceeds 300 grains.

No. 43.

XLIV. SLIVER LAP MACHINE.

A sliver lap machine differs somewhat from the drawing-frame process. The drawing rolls consist of three pairs of rolls, instead of four, as on the drawing frame, but the drawing rolls are similar in construction to those of the drawing frame. Again, instead of the sliver passing to a trumpet, the sheet of slivers passes between two pair of smooth calender rolls, over a polished guide plate, and is wound on a wooden roll, and a lap is formed. The polished plate over which the sheet passes has adjustable sides, and should be so adjusted that a good selvage will be made.

Very little attention need be paid to the draft, because it is usually under 2.5. To enable a short draft on the sliver lap machine, the ribbon lap machine is used. It is at this machine that what we have said as regards friction is proved. Eliminate the

RIBBON LAP MACHINE

and have the laps taken directly to the combers, but before it is put in at the comber it should be unrolled and a yard or two held to the light. It will be seen that the slivers merely lie side by side, and, owing to the frictional contact of the front roll, the lap is uneven, showing both thin and thick places. Again, it proves how a poorer strand of cotton is made by even eliminating one process. So to have a more even lap, the ribbon lap machine is used, which is the second machine in the combing equipment. The ribbon lap machine differs from the sliver lap machine, as can be seen by the illustration which is given in Figure 11.

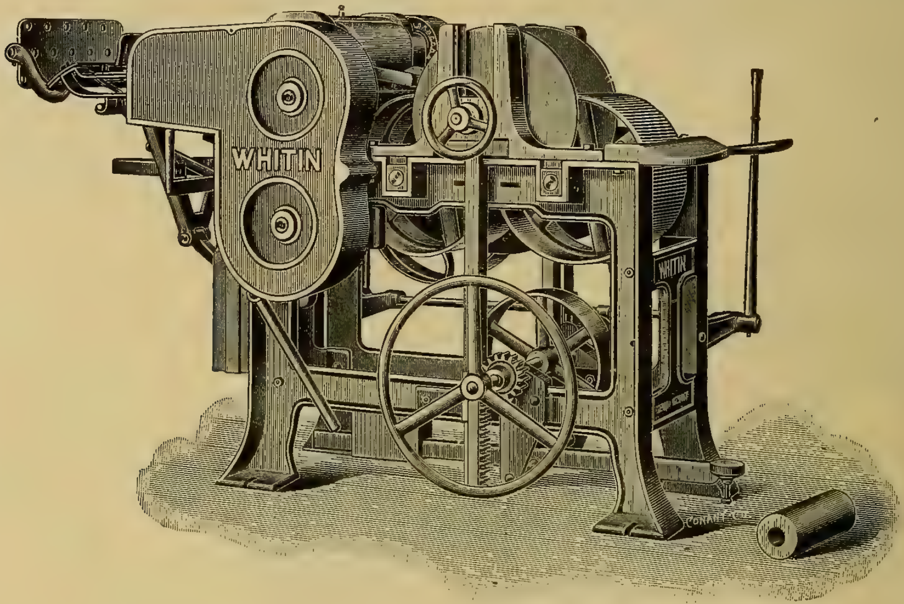


Fig. 10. Sliver Lap Machine.

It can be seen that instead of spoons the strand passes over a plate that acts the same as the spoons on a sliver lap machine, that is, it acts both as a guide and stop motion. Again, the sheet is acted on by four pairs of drawing rolls, instead of three, as on the sliver lap machine. Four rows are employed here because, as on the railway head, the draft between the front and back drawing rolls usually about equals the doublings. Like the sliver lap machine, the drawing rolls are constructed similar to the rolls of the drawing frame. By referring to Figure 11, the sheet delivered from the front roll passes over a curved plate to the table, and passes between the table calender rolls, which serve to condense the several layers of cotton, usually six in number, into one sheet, and to pass it forward. In front of each pair of calender rolls a

GUIDE IS PLACED

on each side of the table to prevent the sheet of lap from spreading. The farthest sheet from the lap head is carried under the sheet that is next to it in direction of the lap head, then from the last pair of table calender rolls, the sheet passes to the smooth calender rolls of the lap head, and a lap is formed ready for the comber.

One point that is much neglected in many fine goods mills, and given but very little attention, is in not having the table calender rolls and table, also lap head perfectly level and in line. When out of line, the several sheets will not run to the lap head properly, which will make the sheet presented at the back of the lap head uneven.

It should be seen that if a lap is uneven at the back of the lap head, the sheet delivered in front will be correspondingly uneven. If a sheet of lap presented to the comber is uneven and not the same thickness crosswise, it can easily be seen that when such a sheet is presented to the action of the cushion plate and nipper knife that a firm grip on all fibres is impossible, and many good fibres find their way to the waste box. No. 44.

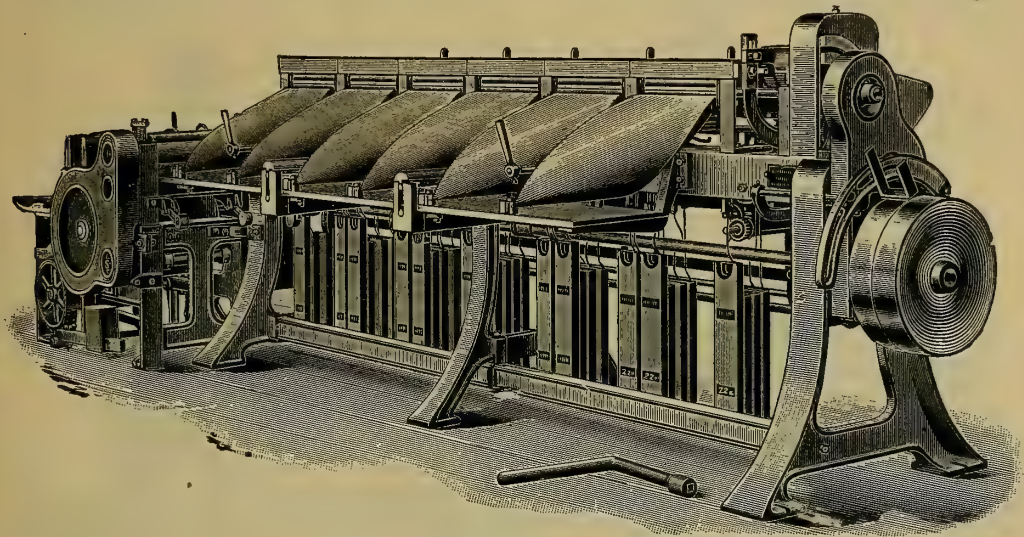


Fig. 11. Ribbon Lap Machine.

XLV. DOUBLE COMBING.

Many mill men are confused when double combing and double-nip combing is mentioned. Double combing means that the cotton is combed and the sliver returned to the sliver lap machine, and the cotton is treated over again by the combing equipment. Double-nip combing means that the combers act on two portions of cotton during each revolution of the cylinder, whereas the single nip-combers

act on only one portion of cotton for every revolution of the cylinder.

Double combing is only necessary when using long-stapled cottons heavily charged with impurities. Sometimes it is necessary to give the cotton a treble combing. Some mill men seem to think that double and treble combing would produce a much superior yarn than single combing. However, such is not the case, although the writer is willing to admit that a double combing certainly improves the character of the yarn. Double and treble combing, as stated, will result in high-priced yarn, both on account of labor as well as the high price of the raw stock which has to be used, for which reason they are seldom employed.

The advantage of double and treble combing can be seen from the following explanation: Suppose we take out 20 per cent of waste with single combing, and when using double or treble combing, a total of 20 per cent. It should be seen that when using double combing we may have taken out only 15 per cent at the first combing and the remaining 5 per cent at the second combing. It can be seen that having double the

QUANTITY OF NEEDLES

or combs acting on the cotton for the same percentage of waste, the fibres will receive a more thorough cleaning and combing action. The reason for the difference in percentage of the two combings, all settings being practically the same, is found in the fact that in the second combing there is not as much waste to be dealt with. And, as we have stated elsewhere, a good deal of trouble is introduced because the fibres have become so parallel and feel so soft that they have a tendency to fly, or if the day is a heavy one, they stick to almost anything.

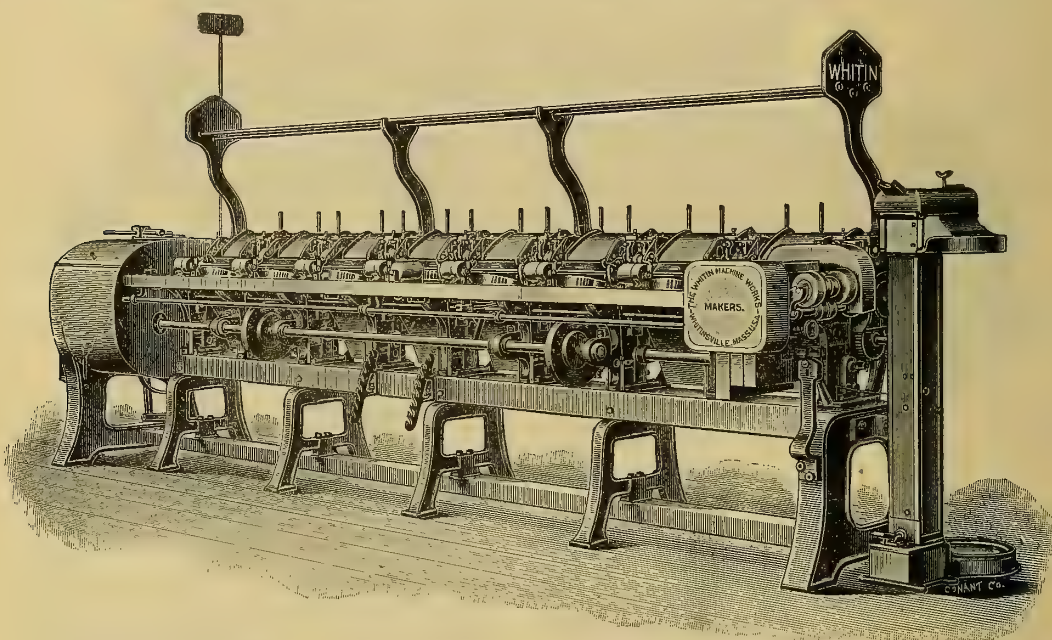


Fig. 12. High Speed Combing Machine, Front View.

The combing machine commonly used is a very intricate one, and possesses a number of interesting features. The front view of the comber having seven heads is shown in Figure 12, and the back view in Figure 13. A cross section of each part of the comber is given in Figure 14, this representing one head. In a complete machine, there are either six, seven or eight heads.

Each head is complete in itself, and receives one of the laps delivered from the sliver or ribbon lap machine, but it should be understood that the motions for all the heads derive their power from the same source. Although each head is complete in itself, the results obtained depend on the accuracy with which the corresponding parts are set so each head will work together. If the corresponding parts have a slight variation, the results will be the same as when a comber is set without taking the

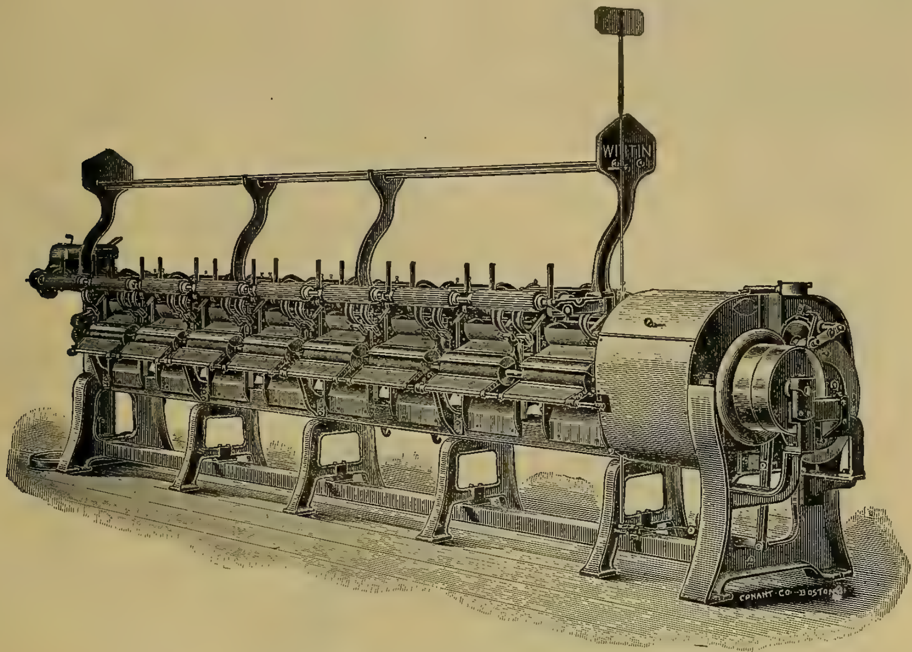


Fig. 13. High Speed Combing Machine, Back View.

AMOUNT OF TWIST

in the fibres into consideration.

If the reader is a comber man, he knows that the corresponding parts of each head must act at the same time, because the bottom steel roll of each head is constructed in one piece and is long enough to serve for all the heads. The laps from this ribbon-lap machine are placed upon two wooden rolls, N1 N Figure 14. What was said about a heavy lap elsewhere holds good here, and the laps from the ribbon-lap machine should be as light as possible, and should under no consideration exceed 300 grains per yard. From the lap rolls the sheet of lap passes over the lap plate A, Figure 14 (which is highly polished) and is fed intermittently by a pair of feed-rolls. The lower roll is formed of steel, with finely pitched longitudinal flutes. The top rolls are cloth and leather covered, having a true cylindrical surface, which is kept in contact with the surface of the bottom steel roll by hooks passing over their necks and suitably weighted. Referring to Figure 14, the bottom feed roll can be seen at K and the top roll at J, the nipper knife at S and the cushion plate at Q. From the feed rolls the fringe of cotton is gripped by the nipper knife and cushion plate, which holds it in such a position that it will be acted upon by the cylinder. The cylinder, Figure 14, consists of three principal parts—the barrel, C, half-lap, Y, Figure 14, and fluted segment, A. The barrel is secured to the cylinder shaft, which goes through the barrel at point C. The

half-lap, Y, is composed of two parts, namely, the

COMB-STOCK

and the matrices. The comb-stock is formed to receive a series of strips of needles, to which is fastened seventeen rows of needles. These needles are so spaced that the needles that first come in contact with the fringe of cotton hanging downwards, are the most widely spaced, and also of a larger diameter than the rows of needles following. The number of needles in the succeeding rows increase, that is, the finer spacing increases until the seventeenth row, in which there are usually ninety needles per inch. And as stated, the needles in the last rows are the smallest in diameter. In other words, the pitch of the needles varies, becoming gradually finer, and ranges from 1-30 to 1-90 inch.

The object of this is to permit the needles to enter the cotton freely and gradually treat the whole of the fibres without running the risk of an undue amount of waste being produced.

No. 45.

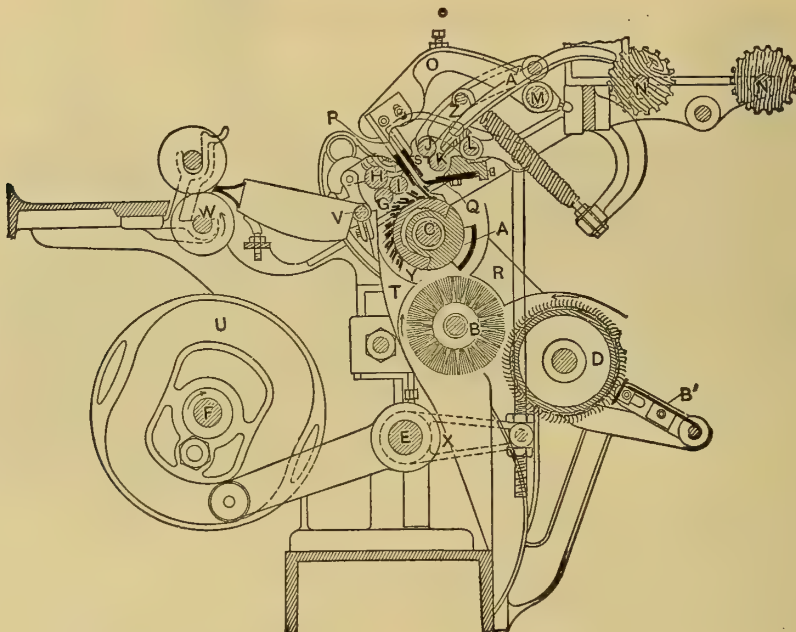


Fig. 14. Section of High Speed Combing Machine.

XLVI. OPERATION OF COMBER.

As stated, the operation of the needles on the half-lap removing short fibres, neps and foreign matter that were not removed in the previous processes, resembles the operation of the licker-in upon the fringe hanging over the nose of the feed-plate, only instead of having a saw tooth, the needles on the half-lap are round and made of steel tapered to a point.

As the cylinder, C, Figure 14, is constantly revolving, the fringe of cotton gripped by the nippers is subjected to the action of the half-lap. It must be understood that this action takes place immediately after the cotton has been gripped by the nipper knife and cushion plate and the latter, at the same time, is forced down by the nipper knife. Again, it must be understood that during this operation the fringe of cotton that is being combed is entirely separate from the fringe previously combed. Here is the chief feature of the comber, to bring back a portion of the previously combed fibres so they may

be pieced up with the fibres that have just undergone the combing operation, a feature, as we have stated elsewhere, which is the basis of strong and weak combed yarn. The overlap necessary at this point will be explained later. After the piecing-up operation, the combed cotton is carried forward and the ends last to

LEAVE THE CYLINDER

receive a combing action from a top comb, which removes any short fibres that have escaped the needles on the half-lap. All short fibres, neps and foreign substances that are removed from the fringe of cotton are carried by the needles of the half-lap, and removed by the brush, B, Figure 14. The doffer, D, Figure 14, which works at a much slower speed than the brush, B, has its surface covered with heavy wire teeth which collect all substances from the brush B. It can be seen by refering to Figure 14, that the doffer is

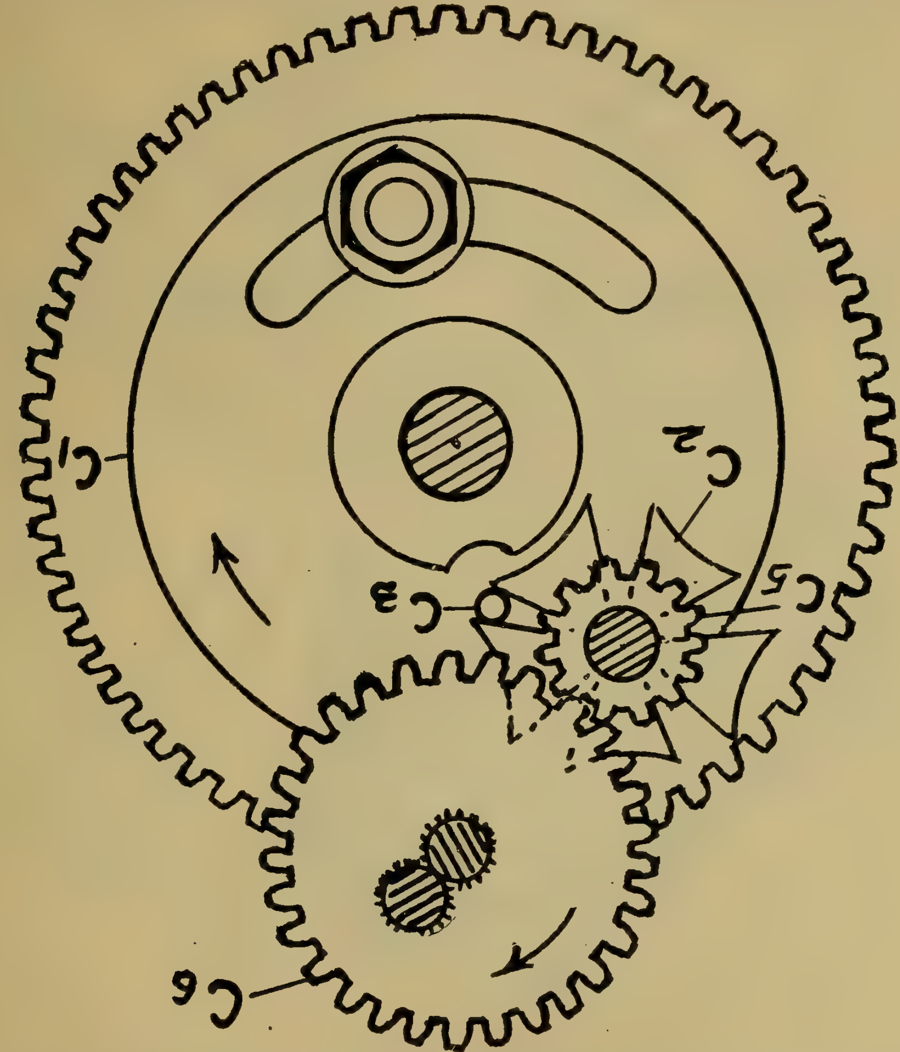


Fig. 15. Comber Head Driving Gears.

not in direct contact with the brush, and that it is the centrifugal force of the highly revolving brush that causes all substances to leave the brush and be deposited on the doffer. As the doffer revolves, most all substances are combed from the doffer, and this waste drops into a can. The operation is the same as that of the doffer comb, combing the web from the card.

Having explained the passage of the stock, the reader should understand that the same operations are again repeated with a new portion of cotton fed in by the feed rolls.

And as the sliver is delivered in a continuous web, it passes through a trumpet that condenses it into a sliver and is then delivered on a table, and with similar slivers from other heads, passes through the draw-box and condensed into one sliver, and then into a can, which is afterwards put up at the back of the drawing frame.

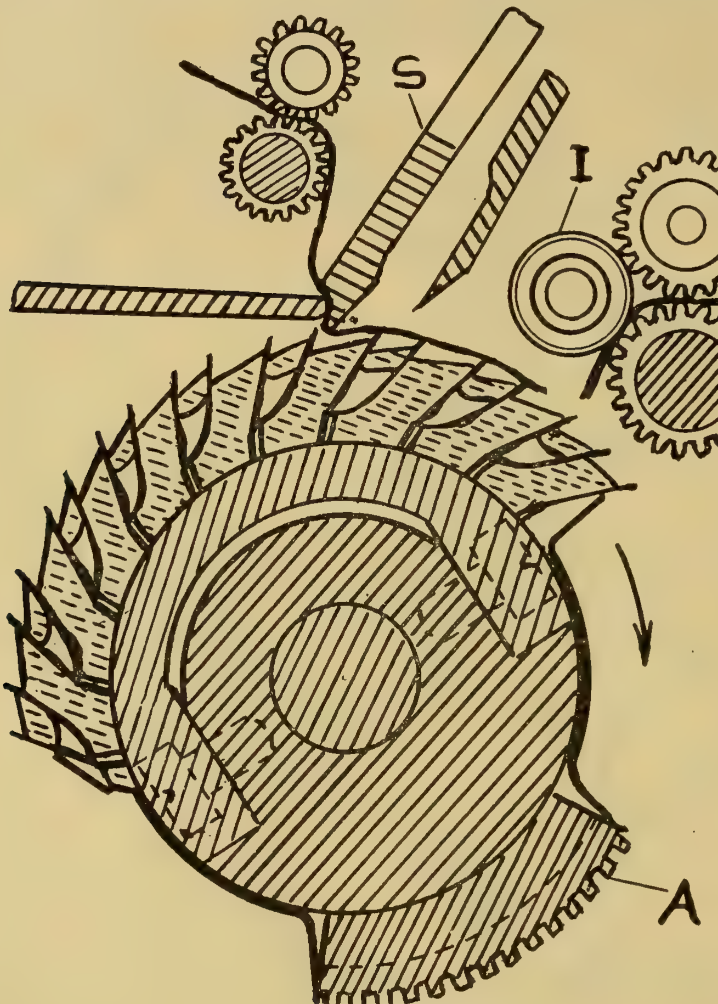


Fig. 16.

The operations of a comber, as a whole, are very intricate, and in

order to understand the many different mechanisms, each operation should be considered separately.

The first operation to be considered is the feed motion. The bottom feed-roll K, Figure 14, as stated, is constructed in one piece and is long enough to serve for all the heads. The reader should understand that in describing a comber it is only necessary to deal with one head, as each head has the same operations.

In order to bring the cotton into a position to be combed by the half-lap, it is first necessary that a certain length of stock be delivered by the feed rolls.

This motion is obtained from the cylinder shaft which passes through the cylinder at C, Figure 14. The comber head driving gears resembles those of the drawing frame head, only somewhat heavier. A very large gear is fast to the cylinder shaft and carries a disk plate C1, Figure 15. A little distance from the centre of the cylinder shaft is a stud carrying a star gear C2. A pin, C3 (usually about ½ inch in thickness), engages the slots in the star gear and turns

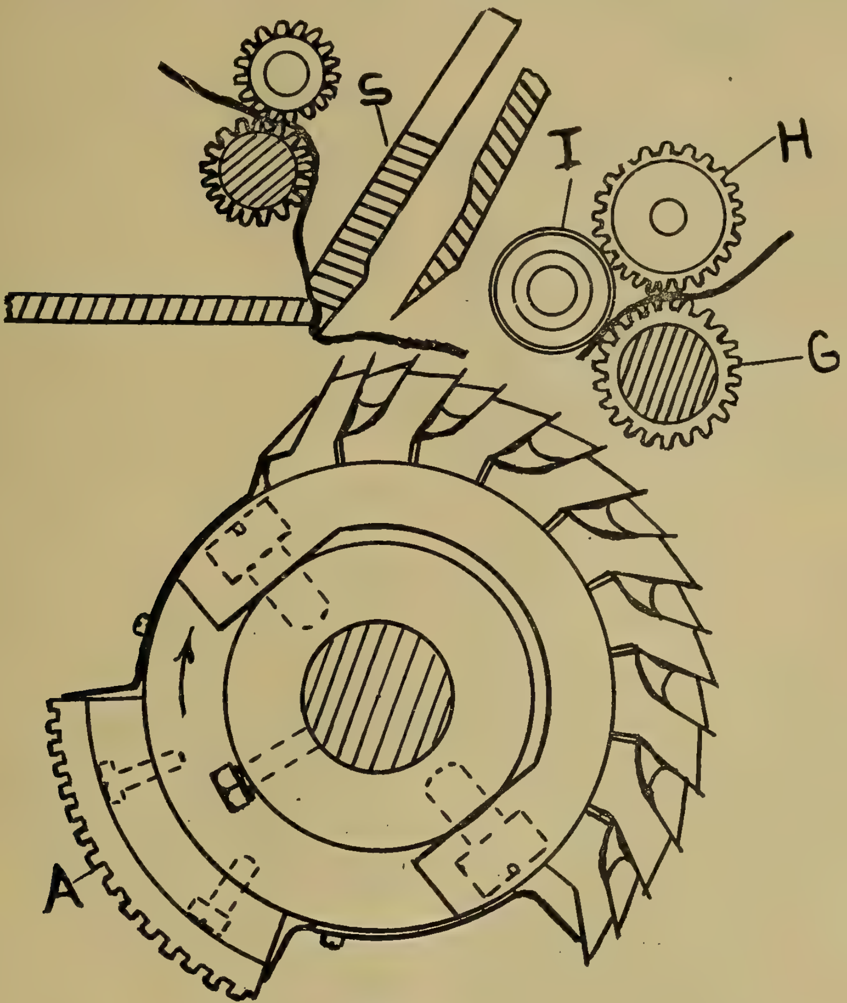


Fig. 17.

it during a part of a revolution of the cylinder. It can be seen by referring to Figure 15, that the star gear, C2, is so constructed that after the pin has engaged with one slot and turned the star gear, the next slot will be in position with the pin at the next revolution of the cylinder.

By again referring to Figure 15, it can be seen that

THE STAR GEAR

is compounded with a small spur gear C5 that meshes with a large gear C6 on the lower feed-roll. From the above it can be seen that for every revolution of the cylinder, the pin C3 engages one of the slots in the star gear, thus turning the star gear a portion of a revolution, and also the feed-roll and the cotton fed to that extent. As the lap rolls are driven from the lower feed-roll by suitable gearing, it can be seen that the intermittent action of the feed-roll is transmitted to the lap rolls. No. 46.

XLVII. ACTION OF COMBER.

When a fluted section of a delivery is 11 inches, a lap 8½ inches should be used. In other words, the fluted section should be at least two inches wider than the lap. The bottom steel roll is usually ⅜ of an inch in diameter. The reason for having such a small diameter front roll on a comber, is to increase the combing field, because the larger a roll is in diameter the farther away is the surface of the roll from its centre.

So, for the same reason, the half-lap is set as close as possible to the front feed-roll. As stated, the fringe of cotton that is fed intermittently, is gripped by a pair of nippers which hold it in such a position that it will be acted on by the needles on the half-lap. The upper nipper is known as the nipper knife, and consists of a little bar of steel, with its lower edge fluted and a portion of this edge overhangs the fluted edge, so that when it moves downward with the cushion plate, this overhanging portion of the front knife and the nose of the cushion plate are brought close to the needles on the half-lap, thus enabling the fringe of cotton to be combed very close to the grip of the nippers, and the combing field is increased.

The lower nipper is known as the cushion plate, and resembles the feed plate on the card, only, of course much smaller. It also has a nose usually covered with strips of soft leather, and fastened by metal strips.

The reason for covering the cushion plate with soft leather is so that it will act as a cushion for the nipper knife, which must press hard on the plate in order to lower it. It can be seen that if the nose of the cushion plate is not properly covered, the fibres will be injured.

By referring to Figure 16, it can be seen that the nipper knife, by having depressed the cushion plate, has brought the fringe of fibres hanging downwards into a suitable position to be acted on by the needles of the half-lap. Figure 16 shows that the half-lap is in such a position at the time the nipper knife has completed its downward motion, that the first rows of needles on the half-lap enter the fringe of cotton, and as we have stated elsewhere, the successive rows on the half-lap are finer, so it can be seen that the successive rows of needles remove all fibres that are too short and have escaped the grip of the nippers and other impurities.

As soon as the needles on the half-lap have passed the fringe of cotton, the ends of the fibres fall into a gap between the needles and the segment, plainly shown in Figure 17, then the cushion plate

BEGINS TO RISE

and occupies the position shown in Figure 17.

By again referring to Figure 16, it can be seen that what we have so far explained can readily be seen in the figure; that is, the nippers are closed, and the cushion plate is lowered to the action of the needles on the half-lap, which are just entering the cotton, and it also shows that, during the combing operation, the fringe of cotton being combed is entirely separate from the fringe previously combed. Again, it shows the detach-

ing rolls G, I and H, are at their farthest position from the needles on the half-lap.

The next operation is the detaching of the partially combed fibres from the nippers and drawing that portion of seen in Figure 18, that the top comb is positioned between the nipper knife S and the leather detaching roll I. As we have stated, the fringe of cotton being combed is not connected to the cotton previously combed, and the

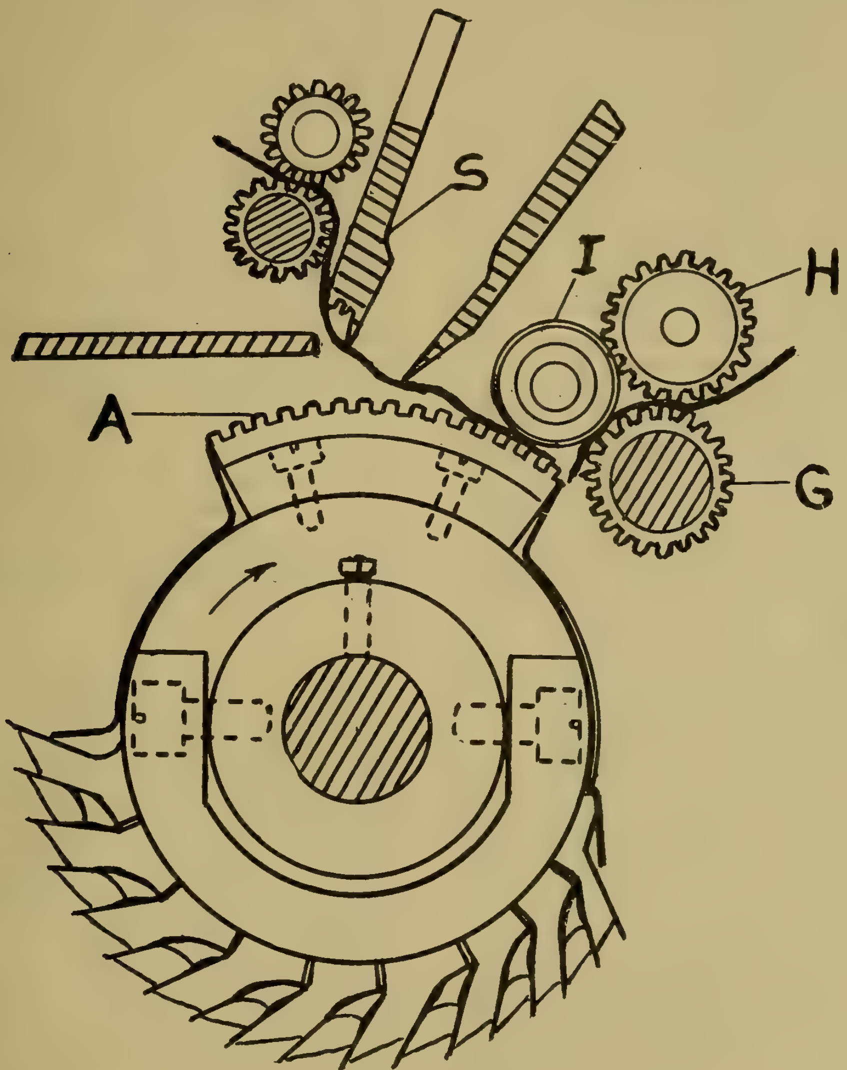


Fig. 18.

the fibres which have been held by the nipper knife and cushion plate, through the top comb, as shown in Figure 18. It can be seen that as the fibres are carried forward, they pass through the top comb. It can also be next operation is the

PIECING-UP

to the cotton immediately in front of it in order to have a continuous sliver.

This is accomplished by returning a portion of the previously combed

fibres, which is plainly shown in Figure 18, the figure shows both the detaching and piecing-up operation.

When the leather detaching roll I is raised from its bearings and is in contact with the segment, as can be seen in figure 18, steel detaching roll G is given its return forward movement, thus delivering forward the stock previously fed back, to which has been pieced the newly combed fibres. The forward movement of the detaching roll is obtained through what may be termed a notch wheel. As stated elsewhere, our aim in these articles is to eliminate all figures possible. All practical men will agree with the writer, that given a figure for each mechanism for each operation is a waste of time, because a practical man knows all about the cams, bowls, levers, pawls and notch gear, and as stated, it is useless to those that have no practical experience on a comber—you cannot learn the practical part in a book. Again, a different mechanism for imparting the rotary motions to the delivery roll is employed on different combers. The detaching roll G, like the bottom feed roll, is made in one piece and long enough to serve for all heads.

A cam not shown is so constructed that the forward movement of the steel detaching roll G is made greater than the backward movement to deliver a length of fibre as long as that which has been combed. By referring to Figure 18, it can be seen that the detaching operation itself is accomplished by the leather detaching roll I. By comparison of Figures 16 and 18, it can be seen that during

THE COMBING OPERATION,

that if the detaching roll were in the position as in Figure 16, the needles of the half-lap would come in contact with the detaching rod. As we have stated, the operation of detaching and piecing-up is the most important, because, besides having the detaching roll set so that it will alternately change properly so that the roll will be near enough to the segment to secure the fibres when detaching and also out of the path of the needles of the half-lap during the combing action, the delivery movement of the delivery roll must be made double its movement in the opposite direction. With the Whitin comber, the piecing segment stands a little higher than the needle segment, and it is, therefore, not necessary to raise the top comb out of the path of the needle segment. So it can be seen from the above that what we have said about the overlapping at this point being the basis of strong and weak yarn is true, because the length actually delivered depends on the amount the delivery movement exceeds the movement in the opposite direction.

The amount of overlap in the piecing depends upon the timing of the detaching mechanism.

The worst evil at this point is when the detaching roll starts forward too late. It should be seen by studying Figure 18, that a long piecing is made and the fibres would have a knotty and curled appearance, thus making the web uneven and cloudy.

On the other hand, if the detaching roll starts forward too soon, we have the opposite effect; that is, the piecing is short and the web has a bad appearance by showing streaks in the web, and, in some cases, the web is cut. No. 47.

XLVIII. COMBER SETTING.

It is impossible to give the exact settings for a comber without taking into consideration the length and construction of the cotton to be combed. as on a card, a good comber man and overseer can save much good cotton for the mill, and prevent also the making of weak yarn by changing the settings. In some mills, as on the card, the settings remain the same, regardless of the stock being run, while in other mills the settings are changed as the staple changes, and also for the different grades of cotton.

As we have stated before, the best comber man is one who understands the construction of the cotton fibres, and also knows a little about the different grades of cotton. The amount of waste taken out of Sea Island cotton is usually from 20 to 22 per cent, and for peeler stock from 15 to 17 per

cent. One good rule to ascertain the per cent is to carefully move all the stock, run the machine for a short time—a half-minute—and then carefully weigh in grains both waste and good cotton. Add the two weights together, and divide the number of grains of waste by the sum. The quotient will be the per cent of waste. Another method is to run the comber for a number of nips. The cotton delivered is kept in one portion, while the waste delivered is taken as another portion. They are then both placed on a pair of scales which denote the

PERCENTAGE OF WASTE.

The following give the approximate settings for combers most frequently used in America:

When setting a comber, the cylinder shaft is primarily the base of all settings, for the reason that the cylinder is centred on that shaft. A more convenient way from which to work when making certain settings is to set the delivery roll given at a true and accurate setting with a certain definite relation to the cylinder. Then the bearings should be fastened, one by one, and the delivery roll should be tried to ascertain whether or not it will revolve freely by passing the hand over its surface. When the delivery roll is properly set and rotates freely, it becomes the base of certain settings of the comber.

In order to have the cylinder and delivery roll in their proper relative positions, the comber must first be lined up. The comber should first be scoured, and all top rolls that are grooved, or that have any sign of looseness, should be recovered. Set the index wheel to five, and with gauge 1⅜ between flutes of detaching roll and front edge of segment, make the cylinder fast on the shaft, and then set the detaching roll flutes to 23 gauge from flutes on segment setting nippers. Then set the cushion plates up to one thickness of thin paper from the nipper knife and to gauge 1¼ from flutes of detaching roll to front edge of cushion plate.

The setting of

THE CUSHION PLATE

to the fibrous packing so that it will bear evenly is properly adjusted by filing the bracket which holds the cushion plate, or by adjusting the knife. It should be the aim always to have the cushion plate rigidly in place, because, by holding the cushion plate rigid, the feed rolls can be set closer to the bite of the nipper knife, allowing short-stapled cottons to be combed, and making the combing field larger when using long-stapled cotton.

It also eliminates the vibration and aids toward making a smooth, easy running machine. After the setting of the cushion plates up to one thickness of thin paper from the nipper knife and to gauge 1¼ from flutes of the detaching roll to front edge of cushion plate, the nipper must be open and the stop screws about one-half way through. Next set the edge of the knife to 21 gauge from cylinder needles, and see that the distance between detaching roll and cushion plate are not altered; there must be a one-quarter gauge between the points of stop screws and nipper stand. Then put on the springs, move the cam until the bowl is on the circular part, put the gauge one-quarter again, between stop screws and stand, and then screw up the nuts on one connecting rod until the gauge is just eased. Turn the cam back again as it was, and try your gauge between

NIPPER KNIFE

and cylinder needles. Be sure that you are clear here and to gauge. Have gauge 1 13-16 between flutes of feed and detaching roll (at bearing).

In setting brushes, let the bristles touch brass of the combs of one cylinder, then make a gauge to go between brush and cylinder shafts and set to it. Set brush tins about one-quarter clear of the cylinder and doffer and about one-half clear where the tin and doffer meet. The lap plates should be set clear of wood and feed roll, but see that brush is set near enough to feed roll to keep it clean and prevent lapping. In setting of top detaching roll, move the 80 gear on cam shaft and turn round the cam shaft until the quadrant moves forward, then set the index wheel to 6¼ and put the 80 gear in gear again, then

turn again and see that quadrant moves forward at 6¼. Top combs should be set as close to the roll as possible without rubbing. If the back row of needles is set as close as the front row, it will be found to be the cheapest way of using top combs.

Following are the settings of a Mason comber:

Comber.	Gauge	Dial.
Edge of fluted segment to detaching roll	1⅛	5
Feed roll to detaching roll (at bearing)	1 13-16	...
Feed roll starts	...	4¼
Edge of cushion plate to detaching roll	1¼	...
Edge of cushion plate to cylinder combs	20	...
Nipper close	...	9
Nipper screws open from bracket	¼	...
Pawl drops in notch wheel	...	1¼
Leather roller touches fluted segment	...	6¾
Leather roll leaves fluted segment	...	9½
Brass roll to leather roll	14	...
Top combs down	...	5¼
Top combs to fluted segment	19	...

Settings of within comber	Index
Nippers open at	3½
Nippers close at	9¼
Lifters down at	6¾
Lifters up at	8¼
Top combs down	5
Detaching roll comes forward at	6
Feed roll comes forward at	4

SETTINGS OF DOBSON & BARLOW COMBER.

	Gauge	Dial.
Clutch closes	20¼	...
Steel detaching roll comes forward	...	6
Nipper close	...	9
Star gear begins to feed	...	4¾
Top comb down	...	5
Nippers to needles	19	...

It should be remembered that close setting makes more waste, and feeding late also makes more waste.

No. 48.

furnished by the builders, and it is a waste of time and space to give what has already been seen many times. As on the card, we will give a short practical method of drafting a comber.

Suppose that a comber has six laps up at the back, each lap weighing 250 grains per yard, and it is desired to find the draft of the comber. For the convenience of calculation, we will assume that the sliver delivered weighs 60 grains per yard. Multiply the weight of the lap fed in by the number of deliveries and divide by the weight of the finished sliver. Example: 250 multiplied by 6 divided by 60 equals 25 draft of comber. To obtain the figured draft add the per cent of the cotton that passes through the machine as waste.

When using the builders' catalogue, the per cent of the cotton that passes through the comber must be taken out as waste, and

THE FIGURED DRAFT

must be diminished correspondingly, in order to obtain the actual weight per yard of the sliver delivered. It can be seen from the method above that it is a waste of time drafting a comber by gears.

As on other machines, the production of a comber depends on the speed, weight of sliver and amount of waste removed.

Below we give a fair speed, also production for 10 hours. Nips, per minute, 85.

Grains per yard of the combed sliver	40	42	44	46	48	50	52	54	56
Pounds in ten hours	42	44	46	48	50	53	55	57	59

XLIX. COMBER PRODUCTION.

On a comber there are two places where there is much draft, and many other places where there is but little. The first is between the steel roll and first calender roll, which is usually from five to six. The second between the back roll in the draw box, and the second calender roll, which is usually from four to five. The total draft is usually from 20 to 30. As we have stated before, all draft calculations for different machines in a cotton mill are found in machine catalogues

A double nip comber will give a greater production than a single nip comber, but does not clean the cotton so well, and light impurities can be detected in the yarn from a double nip comber. The reason is because of the smaller number of needles acting on the fringe. The parts of a double nip comber, owing to some of the parts running at such a high speed, quickly get away from their proper settings and timings, and besides, will wear more quickly. With the results of the wearing and disarrangements of the

timings and settings, bad work is produced. We have stated elsewhere that the settings must be changed even for the construction of the cotton. The reason can be studied by the reader from the explanations already given. The reader should firmly fix in his mind while reading the following summary how a different constructed fibre will

AFFECT THE SETTING

on a comber, that is, if the fibres are not matured, the convolutions are less frequent, and almost altogether absent in the immatured fibre, which affects its length. No. 49.

L. COMBING EFFECT.

It should be seen that when the fibres are ripened, they are twisted many times, and that after passing each process their length is increased some, as was explained. On the other hand, if the fibres are immatured, they have the appearance of a flattened ribbon, when examined under a microscope, and their lengths at each process are not affected, wing to the absence of the convolutions.

Again, the reader should try and think what happens in the combing field during one revolution of the cylinder. When the cylinder has revolved until the fluted segment is in a position to enable the detaching action, the detaching roll descends on the fluted segment, which forms a grip between the detaching roll and the fluted segment that grips the cotton firmly. The fluted segment and detaching roll revolve nearer together, and the fibres that are not held by the grip of the feed-rolls are drawn away. As the fibres are detached, the top comb is in its lowest position, and the fibres that were held by the nippers are drawn through the comb by the detaching roll and segment, and the

DIRT AND SHORT FIBRE,

too short to be held by the segment and detaching roll are removed.

The reader must understand here that particular care must be taken to have the top comb set so that it will not come in contact with the nippers or leather detaching roll. Many mill men advocate using two rows of needles on the top comb. They claim that two rows of needles give a more effective combing. This is erroneous, because the dirt and short fibres will lodge between the two rows of needles that afterwards will drop back into the web of cotton. Again, the proper angle of the top comb is not so easily obtained, besides it is more difficult to straighten the needles if they become bent or hooked, than when a single row is used. As the fibres are detached and drawn through the top comb, the forward ends of the fibres receiving a combing are carried forward sufficiently to overlap the fibre ends that were returned. It should be seen by the reader here that the forward rotation of the delivery roll, which occurs while the segment and detaching roll grips the cotton, assists in piecing up the fibres just detached to those previously combed. In order to clearly understand what happens in the combing field, the reader must know that at this point all fibres

DO NOT PROJECT

from the feed-rolls to the same extent at the one time, no matter how uniform the staple may be. At this point, some of the fibres may not be held by the feed-rolls at all, while others may project beyond the feed-rolls a quarter of an inch, a half-inch, or more.

It should be seen from the above that when the detaching takes place, only those fibres that project beyond the feed-rolls are gripped and drawn forward by the fluted segment and detaching roll, while all fibres that project only partly beyond and are still held by the feed-rolls may now project entirely beyond the rolls.

The reader should see from the above explanations that a wide combing field should always be the aim in the combing operation. This is accomplished by having the cushion plate held rigidly to enable the feed-roll to be set very close to the nipper knife. Again, in order that the fibres may be held the proper distance from the cylinder and that the cushion plate may be set the proper distance from the steel detaching roll, so as to make a good piecing, the nipper bracket

should be given a horizontal and also a vertical adjustment, thus allowing the cushion plate to be set to the detaching roll which again

INCREASES THE COMBING FIELD.

The above setting is mostly understood and can be done only by practical comber men, because it is an important setting, as it requires two adjustments that should be made at the same time, because the adjustment in one way influences the other adjustment.

Combed yarns are much stronger than carded yarn, and can be detected by the naked eye, because they are smoother than carded yarns. On account of the large per cent of the value of combed cotton in the waste which is taken out from the cotton, many fine goods mills run the comber waste over again, which is only carded and prepared for a coarse filling yarn. No. 50.

LI. CARE OF COMBER.

In the comber, as in other machines, certain parts must be oiled, and the needles on the half-lap should be examined often, and all those that are found bent or crooked should be straightened at once.

In mills where every delivery must be kept in operation at all times, there should be extra half-laps, so that if there are too many needles on the half-lap bent or broken, the machine will not have to remain stopped during the time that a half-lap is being repaired.

All parts of a comber should be taken down, and

THOROUGHLY CLEANED,

and repairs made, such as changing the half-laps, renewing the brushes, recovering the doffers, and the cushion plate about twice a year. The brushes that clean the half-laps should have the waste removed from their bristles about every two weeks. The top combs should also be examined very carefully, because, if the needles are bent or deformed in any way, the web will be stringy on account of the cotton passing through the top comb not receiving a proper combing. The leather detaching roll must at all times be perfectly true, and should be varnished every week, because the condition of this roll has much to do with the quality of the yarn. Any defects of the leather detaching roll will cause thick and thin places in the web. All the polished parts of a comber should be cleaned and polished every week.

The overseer and comber man should look at each web often and examine the different settings while passing the comber. For instance, if too much pressure is applied, the nippers will pound, and in time, destroy the settings. On the other hand, if too little pressure is used, it can be seen that many long fibres will be drawn and discarded as waste, and an uneven sliver will be the result.

The proper care of the laps has also much to do with saving top combs. The tender of a sliver lap machine should not be allowed to twist the sliver in piecing. The comber tender should take great care in putting in a new lap and not double the ends. The lap should be broken out and a new lap put in before the end leaves the spool, as it is sure to double up before it is drawn through the feed-roll and spoil the top comb. The has, from time to time, branded the letting of a lap run out on a card a crime, so the same can be said of a comber, because the combing parts on a comber are still more delicate than on the card. In the comber, as on the drawing, if an end breaks on the table or in one of the pans, like a sliver breaking from the delivery of a drawing, it makes the resulting sliver too light. When a sliver is pieced up, the defective sliver that has been delivered into the can for the period that the end was broken should be removed.

Remember this, the amount of waste may be increased: First, by feeding later. Second, by closing the nipper later. Third, by setting the top combs at a greater angle. Fourth, by setting the top combs nearer to the fluted segments.

Also remember that curling is produced because the leather rolls are badly covered or badly varnished or short of oil, and the timing may not be right or the top rolls out of place, or not weighted properly.

PRODUCTION OF COMBER.

The production of a comber is generally obtained by breaking the end at the coiler and running the comber for a minute. The end is again broken and the amount weighed. Multiply the weight delivered in a minute by the number of minutes the comber is run and divide by 7,000. A certain per cent is allowed for stoppages, and this allowance varies according to the number of operatives and the deliveries of the comber. However, 5 per cent is generally allowed. Example: If a comber will deliver 500 grains per minute, how many pounds will it deliver in a week of 58 hours? Sixty multiplied by 58 mutiplied by 95 multiplied by 500 divided by 7,000 equals 236 pounds. No. 51.

LII. FURTHER COMBER SETTING.

Proper treatment of the fibres while passing the combing field depends on two subjects closely related to the machine and very important to the success of the combing process. Most mill men conceive the idea that there is very little difference between setting and timing, which are the two subjects that must be considered in the combing process. Setting means regulating the distance between its working parts by different kinds of gauges as follows: (1) Comber gauge, which is about ⅝ inches wide, and usually about 4½ inches long, the blades at each end varying so as to obtain two different settings with the one gauge. The comber gauges vary from No. 12 to 28 in thickness. The gauges are numbered according to a wire gauge and decrease in thickness as the numbers increase. (2) The step gauge consists of one piece with each successive step 1-16 inch thicker than the preceding one. The first step is generally ¼ inch, second, 5-16; third, ⅜; fourth, 7-16. It is usually ¾ inch wide. (3) The finger gauge consists of one piece, one end being straight, while the other has a curved portion resembling the portion of the human hand between the thumb and forefinger. It is generally 3-16 inch in thickness. It is measured from the centre of the straight end to the centre of the curved portion, the distance varying from 1⅜ to 2 inches. (4) The quadrant gauge consists of a harp shaped piece with a plumb line hanging to the opposite end which is fastened to the machine. The curved part on the side on which the line hangs is numbered and indicates the angle of the top comb, which should be from 25 to 30 degrees. (5) The

CRADLE GAUGE

consists of a casting having two bearing points for the top comb to rest on, besides two set screws that bear against the blade of the comb. The top comb may be held at any angle by simply moving these set screws. In other words, the cradle gauge is used to hold the top comb in position while it is being secured to the comb arms. (6) The brush gauge is used for setting the brush shaft the required distance from the cylinder shaft, and the shafts are made to occupy a parallel position. The brush gauge consists of two castings, one casting having a slot cut into one end for the reception of the set screw on the other casting, by which the gauge length can be increased or decreased. Timing is a process that is employed after all the parts are set. The fact that a comber is intermittent, makes necessary the adjustment of the cams, so that they will operate the different motions, or bring into position the different parts under their action.

Very few persons in charge of combers set alike, and it must be understood by the reader that the settings and timings on a comber vary under different circumstances. The settings and timings in these articles are given so that they may be used as a basis from which to work and obtain an approximate idea.

The extensive correction of the unevenness of the sliver ends at the drawing frame is the most important point in a mill, to get even, smooth yarn. A drawing should have as many doublings as can be afforded, by running a light sliver with a short draft, and at least three processes of drawing should be installed in a

print cloth mill, with six into one on each head. The object of the drawing-frame process is the elimination of irregularities found in the sliver. This is accomplished (1) by doubling the slivers, the more doublings, as stated, the better; (2) by pulling the fibres from one another. The most of the fibres are made to lie in a parallel position, besides it reduces the unevenness in the sliver and also remedies bad and faulty piecings made in the previous processes. Drawing frames are the simplest machines in the mill, and for this reason, their importance in the making of even, smooth yarns is often overlooked. As stated, at least three processes of drawing should be placed in every mill.

For fine counts, four processes should be used; that is, if combers are not used, then three processes would be sufficient. No. 52.

LIII. STOP-MOTIONS.

The most inexperienced help, as a rule, operate drawing frames, and the consequences are frequently disastrous, because, as was pointed out on combers, if one end breaks from a delivery, the resultant sliver is made too light, and, as we have pointed out, this defective sliver should be removed when the broken sliver is put in at the back. Inexperienced labor, as a rule, do not understand this important point, and it is up to the overseer to watch and see that this is done. The drawing frame (one head of four deliveries) electric stop-motion is shown in Figure 19. Figure 20 shows a drawing frame (one head of four

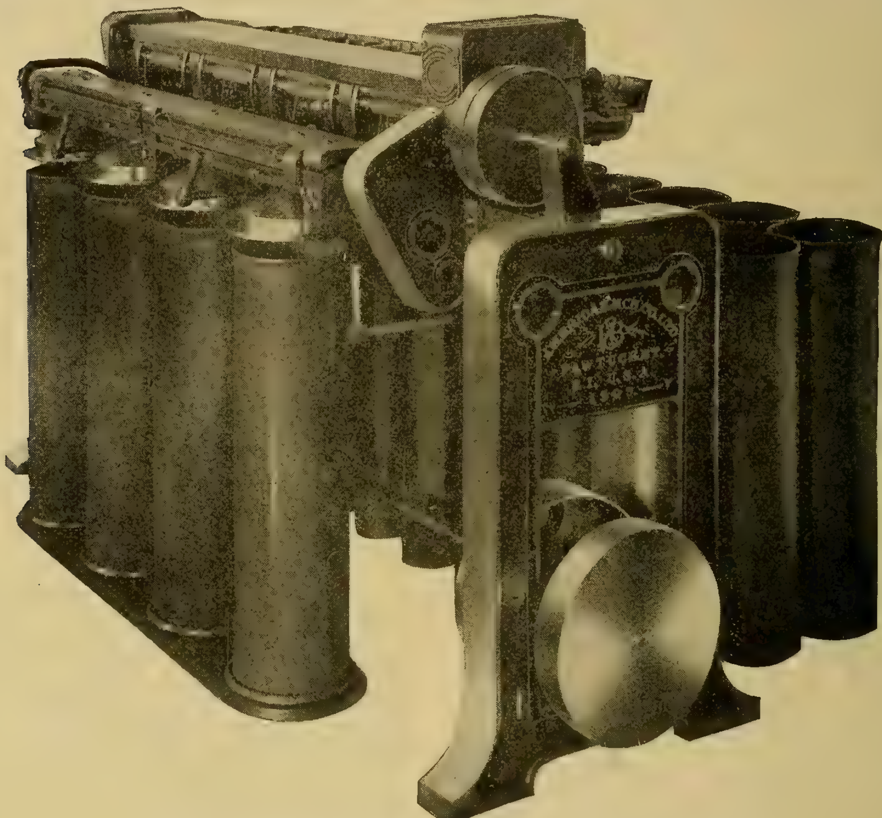


Fig. 19. Drawing Frame with Electric Stop-motion.

deliveries) mechanical stop-motions. It can be seen from the above that two kinds of drawings are generally used in most mills, namely, the mechanical and the electrical. Both have their advantages and disadvantages.

By referring to Figure 21, which shows the sectional elevation of a drawing equipped with metallic rolls, it can be seen that on a drawing frame equipped with the mechanical stop-motion, the stock has to pass through a guide A, over a plate B and the spoon C, then over another guide plate to the back drawing roll. In this process, it is claimed that the drag on the sliver is so great that the weight of the sliver is reduced, especially when the cans at the back of the drawing are nearly empty, thus making uneven yarn.

On the electric drawing frame, Figure 22, the stock passes over a guide A to the dead and preventer rolls. The advantage here should be seen, because through the help of these two rolls

THE DRAG

from the can to these rolls is not as great as on the mechanical stop-motion, and the weight of the sliver is not as greatly reduced.

Fig. 20. Drawing Frame with Mechanical Stop-motion.

Again, with the mechanical stop-motion drawing, if a heavy drawing sliver is run, the draft between the spoons and the back drawing roll is increased. This affects the sliver more as the back can becomes emptied on account of the greater distance from the cotton in the can to the spoon. The greater distance that the sliver has to be carried makes the sliver hug the bottom of the spoon. It can be seen that if the distance between the guide and the can at the

back was always the same; a draft between the spoons and back rolls (although not gradual) would not affect the weight of the delivered sliver much, but, as stated above, the lower the cans are at the back, the lighter the delivered sliver. We know that many readers will take exception with the writer for making such a statement. that exists in all processes of drawings often through its columns, and the readers were asked to size the finished drawing when all the cans in back were full, and then size the same delivery when the cans in back were nearly empty. Surely we must be

When deciding on the proper draft of a drawing frame, there are many points to consider: (1) the number of cards to one delivery; (2) the speed of the front roll; (3) the weight of the finished sliver. An ideal cotton mill should be equipped with one card to each delivery of drawing in order not to have the draft exceed the doublings.

When a mill has less cards than drawing frame deliveries, the sliver on the card, as a rule, is made heavy, which necessitates a longer draft on the drawing. On the other hand, when a mill has more cards than deliveries of drawing, the

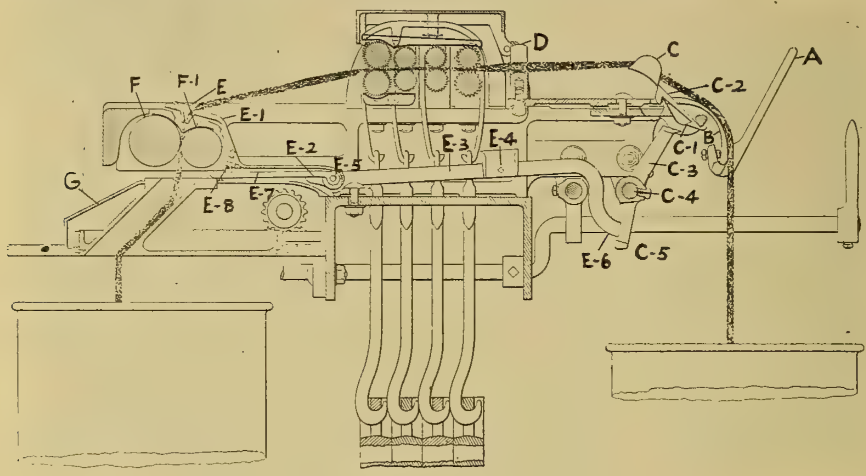


Fig. 21. Drawing Frame—Sectional Elevation—Metallic Rolls.

right, because most mill men do try suggestions, and this is the only way to

IMPROVE THE WORK.

If what we said was not true, many would have corrected us, and we always invite our readers to do this. It should be seen from the above that the cans running in back of a drawing should not be allowed to empty together. No. 53.

LIV. MECHANICAL STOP-MOTION.

The desired weight per yard of each sliver fed depends upon the doublings at the back of one delivery and the total draft of the machine.

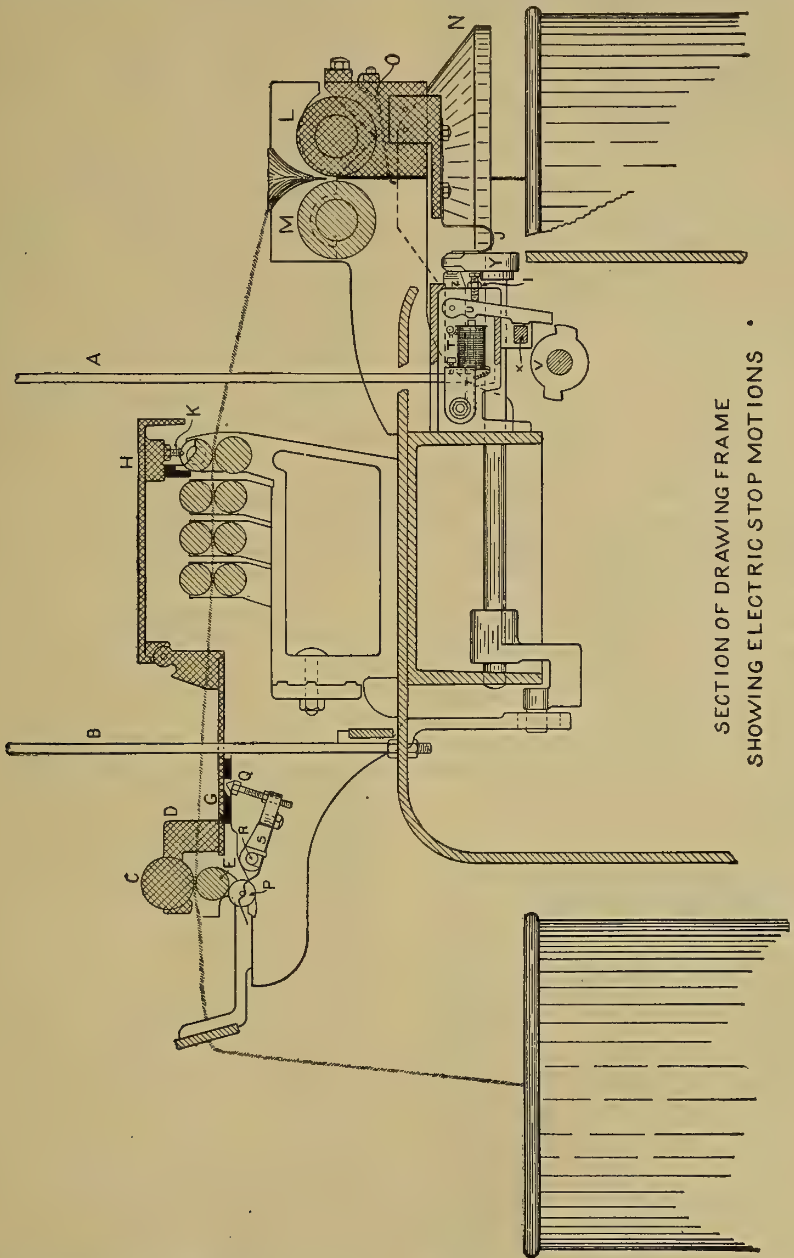
front roll must be made to revolve at a greater speed, or the finished sliver must be made heavier, in order to put through the work of the extra cards. In the latter case, the speed of the front roll should be sacrificed instead of the draft, that is, instead of making the finished drawing sliver heavy in order to put through the work, run the front roll faster and make the finished drawing sliver as light as possible.

When the speed is sacrificed, nothing will suffer other than the wearing of parts not given proper care. Whereas if the

FINISHED SLIVER

is made heavier (say from 60 to 75

grains per yard) the drafts in the next preparatory processes must be made correspondingly longer. Thus, the rolls in after processes are called on to do more work, which produces a greater amount of friction, which is the cause of most uneven yarn. The American Wool and Cotton Reporter has repeatedly pointed out that a finished drawing sliver in any print cloth mill should not exceed 60 grains. What we have said



SECTION OF DRAWING FRAME
SHOWING ELECTRIC STOP MOTIONS

Fig. 22.

about the cans emptying out together on the drawing can be tested by the reader, so also can our satements concerning a light sliver be proved—try it. It will make the bobbins more compact, which proves that the work is more even. When drafting a drawing frame equipped with metallic rolls, it must be remembered that an allowance should be made for the meshing of the flutes, because the diameter of the roll is increased. A 1⅛-inch diameter roll, 16 pitch, should be figured as ten-sixths inches in diameter; 1⅜-inch diameter roll, 32 pitch, should be figured as nine-sixths inches in diameter; 1⅝-inch diameter roll should be figured as eleven-sixths inches in diameter. In figuring the draft of the metallic rolls, for example, if you wanted a draft of 6, you would have a figured draft of about 5.5. So, in order to obtain the actual draft, a good rule is to add nine per cent to the figured draft.

Following is the draft calculation of the common and metallic rolls of the Howard & Bullough drawing.

THE CALCULATIONS

will be of value to all who wish to use metallic rolls. The first figures are to be used in the draft calculation for metallic rolls, the second, for common rolls.

Calender roll diameter 3 inches, equals eighteen-sixths inches; calender roll gear 30, front roll gear driving calender roll 19, front roll gear 22, crown gear 98, draft gear 46, back roll gear head end 71, back roll gear meeting with intermediate gear driving electric roll 20, electric roll diameter 1⅛ inches, figured ten-sixths; intermediate gear meshing into back roll gear 30, intermediate gear meshing into gear on the third roll foot end 23, gear on second roll 30, intermediate gear meshing into gear on second roll 28, intermediate gear meshing into front gear foot end 40, front roll diameter 1⅝ inches, 32 pitch, figured eleven-sixths; second roll diameter, 1⅜ inches, 32 pitch, figured nine-sixths; third roll diameter, 1⅜ inches, 24 pitch, figured nine-sixths; back roll diameter 1⅛ inches, 16 pitch, figured ten-sixths; 18x19x98x71x20 divided by 30x22x1x27x10 equals 257.53, draft constant; draft desired, 6.05; 6.05x.91 equals 5.5, figured draft; 257.53 divided by 5.5 equals 46.8, or 47 draft gear must be used to give an actual draft of 6.05. As stated above, when the draft is figured at 5.5 to obtain the actual draft 5.5 times 1.09 equals 5.99 or practically 6 of a draft.

MORE CALCULATIONS.

For common rolls: calender roll diameter 3 inches, calended roll gear 34, front roll gear driving calender roll 16, front roll gear 22, crown gear 98, draft gear 60, back roll gear 65, back roll gear meshing into intermediate gear driving electric roll 24, electric roll diameter (and all other rolls) as given above, electric roll gear 24, intermediate gear meshing into back roll foot end 30, intermediate gear meshing into gear third roll foot end 36, gear on third roll 24, gear on second roll 38, intermediate gear meshing into gear on second roll 24, intermediate gear meshing into front roll gear foot end 40, front roll gear 20.

EXAMPLE.

24x16x98x65x24 divided by 34x22x1x24x9 equals draft
363.35.
constant.

363.35 divided by 60 equals 6.05 draft.

The above figures will be found valuable to those changing from common rolls to metallic rolls. The metallic rolls are increasing in favor, because they certainly do give a constant draft, and on heavy work this is attained with light weighting of the top rolls. No. 54.

LV. STOP-MOTION OPERATION.

Figure 21, as shown in our issue of November 10, represents a cross-section of one delivery equipped with mechanical stop motions. Each sliver (usually six in number) passes through the guide A, over the plate B, and the spoon C, each sliver passing over one spoon. The slivers next pass over another guide D, and then to the drawing rolls. From the drawing rolls the slivers pass to the trumpet E, where they are combined into one, then through the calender rolls

F and F-1, through the coiler tube G, into the can. The trumpet E is supported by the lever, E-1. The spoon is supported at point C2, and is free to swing up or down, its lower end being always slightly heavier than its upper end. As stated, the

TENSION OF THE SLIVER

passing over the spoon keeps the heavy end C1 of the spoon out of contact with a projection on the arm C3, which being set screwed to the shaft C4, oscillates with that shaft. It can be seen then that when an end breaks, the end of the spoon C1 engages with the projection on arm C3, and the shaft C4, is prevented from oscillating, which causes an arm to be forced against a casting, which indirectly ships the driving belt from the tight to the loose pulley.

When the sliver breaks in front, the action is somewhat the same as in the back. A lever, E3, is pivoted at E5, and carries a weight E4, which tends to lower its outer end. The lever at its forward end carries a lug E2, that bears against the lever E7, carried by the lever E1, which also bears against an adjusting screw E8, carried by the lever E1, that supports the trumpet. It can be seen that the action here is the same as in the back, because in case the sliver is running through the trumpet, it causes enough tension to hold down the lever E7, and as this lever rests on the lug E2, the weight, E4, is prevented from lowering the end of the lever E6, and it cannot engage the projection on the arm C5. On the other hand, if the web should break, the outer end of the lever E3 is forced down by the weight E4, and E6 comes in contact with the projection on the arm C5, which prevents the shaft C4 from oscillating, and stops the machine, as explained. The drawing frame equipped with

MECHANICAL STOP-MOTIONS

stops automatically when the sliver runs out or breaks at the back, when the web breaks in front, and when the cans at the front become full.

Only a brief description is given of the mechanical stop-motions, because they are the oldest type of stop-motions, and are understood by most mill men. As we have stated before, our aim is to point out the defects existing in the different processes, instead of only explaining the operation of machines which are understood by almost all persons laboring in a cotton mill. The spoons C, Figure 21, are changed when the weight of the slivers are altered over 10 grains per yard. It should be seen that the spoons C should be lighter at C1, when running a light sliver, and besides the spoon at C should be closed a little more. On the other hand, if the sliver is made heavier, the spoon should be opened a little more, and C1 made heavier.

If the same spoon running a light sliver is used for a heavy sliver, what we have pointed out about a draft being caused between C and the back roll is true; because the smaller the channel in C the more resistance it gives to the sliver passing into it. Again, think what a distance the top of the can is from C when using 12-inch cans. Such cans occupy a much larger floor space than the 10-inch cans, which makes the distance from the outer row of cans to C very great. Thus, even when the cans are all full, there is more of a drag on the outer row of cans, which makes the work uneven.

No. 55.

LVI. MECHANICAL STOP-MOTION DISADVANTAGES.

But think, when standing at the back of a drawing equipped with mechanical stop-motions, what a great distance the sliver has to be carried from the bottom of the can in the outer row to C. As we have stated, if the skeptic would size the delivered sliver when the cans are nearly empty (especially when 12-inch cans are used), if he is a carder, he would not care to admit the variation. On the other hand, the writer has lately visited mills where a light carded sliver is run, which is the proper thing to do, but the spoon, if left at liberty, will continually be overbalanced on

account of the light sliver decreasing the tension on C. So some mills place a speeder bobbin between C and D, Figure 21; other mills cut broom sticks in small lengths and use a wire passed through its centre, which serves as an axis for the small wooden roll made from the broom stick. The ends of the wire forming the axis are bent and fulcrumed at D, so that the small wooden roll will rest on the slivers between C and D. In other mills the writer found the same wooden roll, only instead of being fulcrumed at D, holes were bored into the plate at C2 and they were fulcrumed at that point.

The writer is willing to admit that the builders are not to blame for such existing conditions, because they always have on hand

THE PROPER SPOONS

for any weight sliver generally used in cotton mills. And in justice to the overseers in some of the mills, the writer has visited, it must be said that they too are blameless, because the superintendent thought it was a waste of money to buy such spoons. Let us see the evil this defect will cause.

It takes away the advantage the mechanical stop-motion has over the electrical stop-motion; that is, when the proper spoons are used, if the sliver running in at the back does not contain the necessary doublings of laps, which is termed single, C1 will overbalance C, Figure 21, and the frame will continually keep knocking off until this defective sliver is removed. Thus it can be seen that when the proper spoon is used, it is impossible to run single, a feature that makes the mechanical stop-motion drawing superior to the electrical stop-motion at this point. On the electric stop-motion drawings, no stock whatever must be between the preventer roll and dead roll to enable the frame to stop. It can be seen that when using a bobbin or a wooden roll between C and D, that besides allowing the spoon to run single, the draft is increased still more at this point. It must be understood that what we have said regarding the tension of the sliver increasing as the cans become lower, applies to the electrical stop-motion as well, only, as stated, this defect does not affect the sliver as much, owing to the

AID IT RECEIVES

from the preventer and dead rolls with the electric stop-motion. In most mills the writer has visited, the cans in back of the drawings running in one delivery, are put in altogether and they wonder why they have soft and hard bobbins on the speeders. One of the carders said that when all the cans were full at the back, he very seldom had a variation of more than one grain. I was ushered to the finished drawing, and here he sized six deliveries separately. Following are the weights of the slivers in grains: 65, 65, 65, 64, 65, 64. I admitted that that was very good, and for his own good, I asked that he size the same slivers when nearly empty. This was done with the following results: weight in grains, 61, 62, 63, 61, 61 and 63. There was a difference of 17 grains in six yards of sliver from full and nearly empty cans.

When sizing, some carders gather all the slivers of one head together, placing them on a measuring board then cut and weigh in bulk. In this case the bad work of a single delivery, caused by a lap on the back rolls, or the rolls not being properly oiled, or the weight hooks having been disturbed, or one of the deliveries not having the proper number of slivers at the back, is not discovered. If the slivers are weighed separately and any of the above evils should exist, the sliver will be either too light or too heavy. The rolls producing a sliver not of standard weight, should receive immediate attention in order to locate the cause. No. 56.

LVII. SIZING THE SLIVER.

When sizing the drawing sliver, the cans at the back should be examined to see that they all empty in intervals, that is, when running six into one, one can should be 1-6 full, the next 2-6 full and so on. They should be arranged so that when the six cans of the previous process are doffed, the

six cans will be put into six deliveries. This is the only way to keep the work even. For instance, assuming that a certain mixing of cotton is very fluffy, which all carders know makes the work run very light. it can be seen that when the carded slivers are made lighter by such a mixing of cotton and put up at the back together, the variation in front of the first process of drawing is six times greater.

Again assuming that all the slivers from the first head of drawing are put into a delivery in the second head of drawing, it can be seen that the delivered sliver is made very much lighter than the other slivers on the same head.

On the other hand, if the six cans were divided and one can put into each delivery, as stated above, the variation will be slight. So it should be seen from the above that it is this variation in the slivers that causes hard and soft bobbins which makes the warping very bad.

Again, when sizing, if

THE SLIVER

delivered is from nearly empty cans, the sliver will show light, which is very misleading. The gears are often changed to make the work heavier, then when the sliver is again sized and the cans at the back are nearly full, the sliver will be found too heavy and the gears are changed back again. This makes very uneven work. If every carder will arrange the drawing cans so they will empty in intervals, it will be found possible to obtain an even sliver. But, as stated above, it is a good method to examine the cans in back every time the drawings are sized, and if all the cans are found to be running low at the same time, the tender should be made to understand the variation this arrangement will cause to the finished sliver. Changes should be made at the finisher drawing as much as possible, because changing draft gears on fly and jack frames causes more or less cut roving, due to the back lash in the gears, besides changing the diameter of the roving during the building of a set often necessitates changing the rack gear. Drawing tenders should be trained so as not to make piecings that are too long at the back, because such piecings will extend through the drafts in the after processes and will make heavy lengths of yarn that can be detected in the cloth. Some mills change from a heavy to a light sliver without considering the size of the trumpet.

When changing from coarse to fine work, and the drawings are not equipped with trumpets (a mistake, the builders are continually making by not having changeable trumpets), the plates should be bored and a trumpet made of brass inserted. For 50 to 60 grain sliver, the hole in the small end of the trumpet should be five thirty-seconds inches in diameter; for 65 to 80 grain sliver, three-sixteenths inches in diameter. Having the proper size trumpet is important, because a large hole in the trumpet will allow bunches and clearer waste to follow the sliver to the can. On the other hand, a small hole will allow only the passing of the sliver, besides condensing it. No. 57.

LVIII. DRAWING FRAME DEFECT.

A great mistake that is made in the construction of a drawing frame (machine builders take notice), is in having the end of the trumpet too near the bite of the calender rolls. What we mean is that when a strong, wiry cotton is used, the distance between the end of the trumpet and the bite of the calender rolls is so small (usually one inch, which is shorter than the average staple), that the contact of the two calender rolls which form the bite is not sufficient to either break or pull the heavy defective part through the trumpet, with the following results: that the surface of the two calender rolls only slips over the part of the sliver held between the calender rolls, the resistance offered by the trumpet combined with the strength of the staple preventing the trumpet from operating the stop-motion on the mechanical drawing,

and also on the electric drawing, by the calender rolls being kept out of contact. All carders know that this defect is the cause of most all bad roller laps that result in the bending of the drawing rolls and the breaking of gears. When the

CALENDER ROLLS

fail to break the sliver between the end of the trumpet and the bite of the calender rolls, and the trumpet becomes clogged up, the web accumulates, until caught by either the top or bottom front rolls, with the results as stated above. If the machine builders would increase this distance by making the tube in the trumpet shorter by one-fourth of an inch, most of this knocking-off failure would be eliminated. The writer experienced the above trouble, but fortunately the trumpets were made of brass and inserted in the holes in the plates instead of only having holes in the plates serving as trumpets. One-quarter of an inch can be cut off each trumpet, with the result that not a single drawing roll will be sent to the machine shop to be straightened.

Another important point to watch about the drawing, is the tendency of drawing frame tenders to pass the cans from the first process to the third, skipping the second process. If the second process that is skipped has a draft equal to the first process, it will not make any difference to the ultimate weight of the yarn, but if the frame skipped has a different draft, the omission of this process is serious and causes much uneven work. In either case this should be branded as a crime.

No. 58.

LIX. ELECTRICAL STOP-MOTION

In considering the electric stop-motions, the reader should give some attention to certain laws of electricity, in order to understand how it is possible to apply this class of stop-motions to cotton mill machinery. The action of the stop-motion is dependent upon some suitable apparatus, which generally consists of a small dynamo placed on a mill post above the frames. By referring to Figure 22 (in our issue of November 10), A is one terminal of the generator, and B is the other. There are two classes of substances, conductors and non-conductors: (1), a conductor is a substance through which an electric current can readily pass; (2), a non-conductor is a substance that offers great resistence to the flow of electricity. Metals are good conductors, while glass, oil or cotton are non-conductors. The electric current must flow from one part of the dynamo through the electro magnet T, Figure 22, through the various connections and back again to the dynamo in order to have a complete electrical circuit. By referring to Figure 22, the parts that be seen that the cross section of the by means of insulations (indicated by of drawing rolls, and the back calender roll M, are all directly connected to the framing of the machine which in turn is connected to terminal B. The parts that have their cross section double lined, as the front calender roll L, the preventer roll C, and the cover or top clearer H, are all connected to pole A. By have their cross section single lined, drawing is divided into two parts such as the dead roll E, the four sets again referring to Figure 22, it can the solid black portions). One part, as stated above, is connected to the magneto through the down rod A, and the other part through the down rod B.

It will be seen that in case of each stop-motion the parts are kept from coming into contact by cotton passing between them (cotton being a non-conductor), the circuit is not completed, and the magnet will not attract the finger U into engagement with revolving clutch V. On the other hand, if any part of one pole is brought into electrical contact with the other, the electric current is completed, allowing the current to flow through magnet T, which attracts finger U into engagement with revolving clutch V, and by a mechanical arrangement, shifts the belt on to the loose pully. The magnet box is bolted to the framing of the machine. The block B, is insulated from the

magnet box by a fibre insulator which is placed between the block and the magnet box, and also by a fibre bushing for the reception of the bolt that fastens the block to

THE MAGNET BOX

A spring J is fastened to the framing. Between the spring Z and J, is an eccentric Y, which serves for what may be termed a switch, because when the frame is running, Y is in contact with both springs. As the machine stops, the movement of Y takes it out of contact with Z, but should always be made to press against Y. The spring J, as stated, is bolted to the framing and is not insulated from it. As cotton is a nonconductor of electricity, it can plainly be seen that when cotton passes between dead roll E and preventer roll C it insulates them, as it does also the calender rolls M and L, and prevents any electrical connections. On the other hand, if the frame is in operation and a sliver should break or one of the cans at the back should become empty, it can be seen that the preventer roll C would come in contact with the dead roll E, which will allow a current to flow through the magnet T, which attracts finger U into engagement with revolving clutch V, and by mechanical means, the driving belt is shifted onto the loose pully.

The finger U is supported by a small wire, which is set-screwed to it, and is free to swing. The distance between the core of the magnet and the finger should be about one-eighth of an inch. This will be close enough to attract the finger, and at the same time allowing enough space so that the lower end of the finger will engage the revolving clutch V.

When the finger U engages revolving clutch V, the

CLUTCH WILL STOP

at the point of engagement if the magnet is set so as to give enough space for the finger to be drawn far enough. This throws out the back half of the clutch of which it is a part. If the magnet is set too close to the finger, the engagement of the finger and clutch will not be as effective, owing to its swinging space being reduced. When such conditions exist, much single is allowed to run through.

The back part of the clutch, when thrown out, comes in contact with a forked shaped lever supported and fastened to the cross shaft. When this forked lever is forced back, the shaft is turned slightly, which in turn acts on a linkage, which moves the shipper and stops the frame.

No. 59.

LX. ELECTRICAL STOP-MOTION TROUBLES.

When the shaft is turned slightly, Y is thrown out of contact with spring Z. It must be understood that in order to operate all other heads, the circuit at this point must be broken as soon as a short circuit has stopped the machine, because from what we have said above, it should be seen that if the circuit was not broken between Z and J, a steady flow of electricity would be passing through the magnet when the frame is stopped, which would rob the other heads from the current necessary to attract the finger, with the result that, owing to the weak current, a frame would run a considerable length of time, in some cases the current being so weak as to not attract the finger at all. Sometimes the cotton laps around the rolls in such a way that screw K comes in contact with the cotton, and is kept insulated from the roll. When this happens, the frame may run until the consumption of power is too great for the small driving belt, and the frame stops with the driving belt on the tight pulley. Thus Y is in connection with both spring Z and J. If, with the machine in this condition, anything connects electrically the two parts of the machine which are normally insulated from each other, a short circuit results, which, as stated, robs the other heads of the necessary power to draw the finger and knock off the frame.

The writer has seen

THE OVERSEER,

second hand and grinder hunt a long

time to locate the cause of all the heads having no power, when the above condition was the cause of all the trouble. Another cause for trouble of this kind when the frame is stopped, is by Y being moved slightly to occupy another position on the shaft, so as to keep it in contact with springs Z and J at all times. It pays to watch Y and see that it clears Z when the frame is stopped.

As the frame stops, the part X forces the finger U away from the clutch, which leaves the clutch free to turn when the frame is again started. The underclearer P presses against the bottom electric roll E. In case the cotton laps around E or P, the screw Q is lifted and touches the back plate G, which completes the circuit, and the frame knocks off. The top clearer cover H has a screw K on the underside. If the cotton laps around the top or bottom front roll, the top roll is lifted and comes in contact with screw K, which completes the circuit and the frame is knocked off. When the cans at the front are full, the cotton presses against the coiler top N, is lifted into contact with the spring O, and the circuit is completed, thus stopping the machine. If the frame continually stops, the first thing to do is to raise all top clearers, and to try the machine with the clearers raised. If the machine does not knock-off with the covers raised, then lower the covers, one at a time until the cover making the trouble is found, when the screw K should be then adjusted. On the other hand, if the frame continues to knock-off with the top clearers raised, then the preventer rolls C should all be removed, and if this stops the trouble, they should be placed in position one by one, until the roll making the trouble is reached, when the guide D should be so set as to keep it in a proper position.

THE CHIEF TROUBLE

in the operation of the electric stop-motion, is short circuits, either in the machine itself or before the current reaches the spring J. If the wires A and B come in contact, or if a conductor is accidentally laid on the frame so as to connect the two poles, the generator is short-circuited, and every drawing frame connected with the current, will fail to stop. In such a case, the first thing to do is to place a piece of metal between the insulation bodies (a good place is between the conductor A and the magnet box) and if sparks can be obtained, they indicate that the dynamo is in proper order. The second thing to do is to disconnect all the feed rods A at every head, taking care that the end of the feed rods are clear from any part of the drawing frame. Then connect the feed rods one by one until the head of drawing causing the trouble is determined. A drawing frame, which keeps stopping when the feed rod is connected, indicates that it is the head causing the trouble. The rod should be disconnected again, and that certain frame left stopped until repaired.

It should be seen that the stop-motions on a drawing frame are important agents for the eveness and quality of the work, and it is the sensitiveness of the stop-motions that makes the most even finished sliver. No. 60.

LXI. DRAFTING CALCULATIONS.

As we have said in the beginning of these articles, the writer assumes that the reader is familiar with cotton mill machinery. But for the benefit of those that are familiar with cotton mill machinery and who do not understand the art of drafting, we will fully explain it here. We have given elsewhere the different methods of drafting, and the rule for calculating one machine is the same as for others. When drafting a machine, consider the back roll a driver. For instance, when drafting a drawing, multiply the diameter of the calender roll, and all the driving gears together and divide this product by the product of the diameter of the back roll and all the driven gears. The draft of the latest type of drawings is in four places, between the back and third rolls, the third and (usual the break draft) second rolls, the second and first rolls, and between

the front and calender rolls. All beginners learning drafting should first find the draft between the rolls, and then multiply these drafts together to obtain the total draft. All learners should know that the total draft is the using the gearing connecting the two rolls we have 30x26x33 divided by 28x 20 equals 45.95 plus revolutions of the third roll; 1⅜ (inches) x3.1416 equals 4.3197 circumference of the back roll; 1⅛ (inches) x3.1416 equals 3.5343 cir-

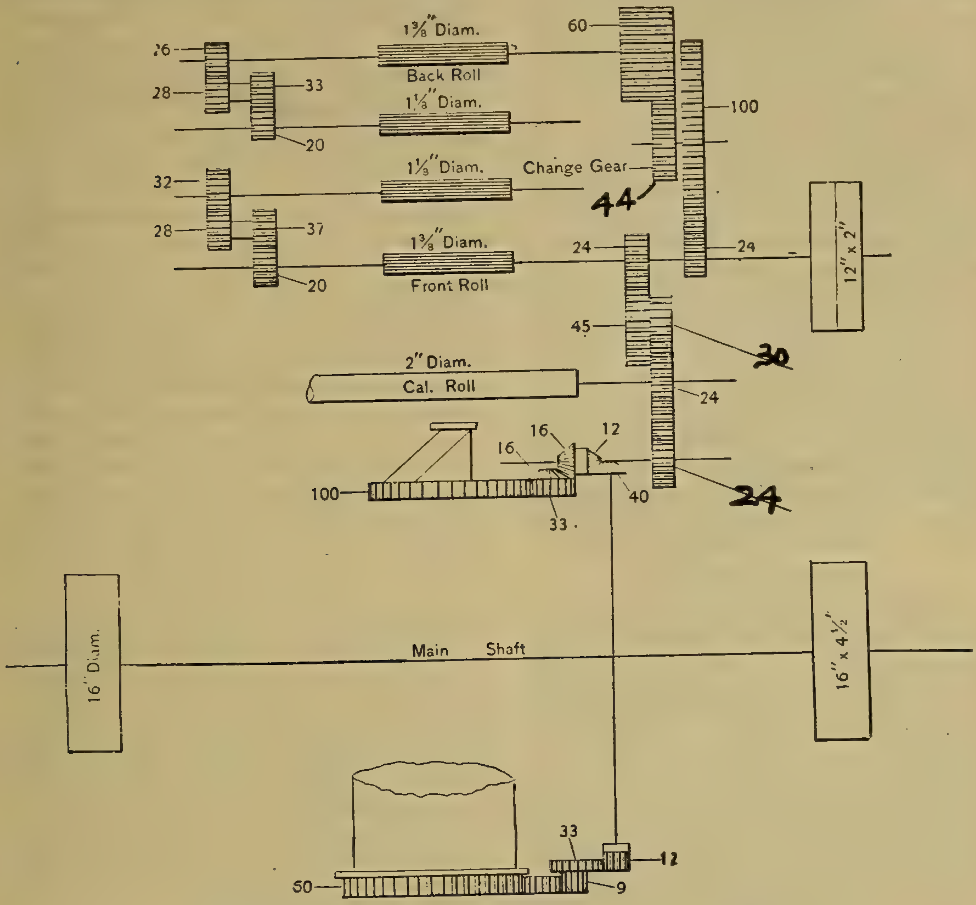


Fig. 23. Drawing Frame—Diagram of Gearing.

product of these, and not the sum, as many believe. Referring to Figure 23, the draft between the fourth and third roll is 9x33x26 divided by 20x28x11 equals 1.253 draft. To prove the above draft, find the surface speed of the back roll and divide into the surface speed of the third roll.

CALCULATION.

For the convenience of calculation we will assume that the back roll is making 30 revolutions per minute, then cumference of the third roll; 30x4.3197 equals 129.591 inches delivered in one minute by the back roll; 45.95x3.5343 equals 162.401 inches delivered in one mnnute by the third roll; 162.40 divided by 129.591 equals 1.253 draft between the back and third roll, thus proving the draft at this point.

It can be seen from the above that any beginner can employ the above method which will give him confidence when otherwise he may be in

doubt of the figured draft. Such methods should be used in textile schools; that is, every student should learn not only going one way, but should be able to come back and prove his figures, besides employing a second method described above to prove the figured draft. Some may say that such methods take up too much time, but it should be remembered that the above method is used only to find the constant draft, because if the constant is wrong, you are all wrong. The draft between the third and second roll is obtained by the diameters of both rolls, and following the driver and driven gears. Be sure, when drafting, to put the second roll diameter on the dividend line. 9x28x20x100x60x28x20 divided by 32x37x24x44x26x33x9 equals 1.753 draft between the second and third roll, which is known as the break draft. Next we find the draft between the second and first roll: 11x37x32 divided by 20x28x9 equals 2.584 draft. The draft between the calender and front roll: 16x30x24 divided by 24x45x11 equals .969 draft.

DRAFT CONSTANT.

Then to obtain the total draft: 1.253x1.753x2.584x.969 equals 5.4998 or 5.5 total draft. To prove the above figure, the draft from the calender roll to the back roll, 2x30x24x100x60 divided by 24x45x24x44x1⅝ equals 5.509 total draft. As stated, the best method is to first find the draft constant and prove the draft constant found by the method given above; then the constant can be used for a dividend. To find constant call draft gear 1. 2x30x24x100x60 divided by 24x45x24x1 x1⅝ equals 242.42 draft constant. Divide back gear into constant to obtain the draft: 242.42 divided by 44 equals 5.5 total draft. If a draft of 5.5 is desired, divide the draft desired into constant to obtain the draft gear: 242.42 divided by 5.5 equals 44 draft gear.

The reader will notice that there is only a draft of .969 between the front roll and calender roll. Such a draft is only possible when a very heavy sliver is run. The gear 30 can be changed from 30 to 33 on common rolls, the lighter the sliver and the less friction on the front roll, the larger the gear used must be to take up the amount delivered by the surface of the front roll. This is a problem that many do not understand, that is, to have the figured surface speed of the front roll (as above) greater than the surface speed of the calender roll. The American Wool and Cotton Reporter has continually pointed out this evil which is the cause of so much uneven work in a cotton mill. Such conditions are not found when using metallic rolls, and for this reason they are preferred. If the reader will go back to our article entitled, "The Well-managed Mill and the Ill-managed Mill," he can then form an idea as to what happens between these two rolls when the finished sliver delivered weighs 85 grains to the yard. When a draft less than one exists between the front roll and calender roll, owing to the frictional contact not being positive between the front steel and leather roll caused by running a heavy sliver, it can be noticed that such a draft exists. When the frame is started, the slivers

WILL SLACKEN

slightly and the sagging will disappear as soon as the front roll is at full speed, when the friction is felt on the web. The reader can prove what we say here is true, by proving the draft here, as between the last and third roll given above: 1⅜ (inches) x3.1416 equals 4.3197 circumference of the front roll. 2 (inches) x3.1416 equals 6.2832 circumference of the calender roll. Now it is assumed, as in the previous example, that the front roll is making 30 revolutions per minute: 30x24x30 divided by 45x24 equals 20, speed of calender roll; 4.3197x30 equals 129.591 inches, delivered by the front roll in one minute. 6.2832x20 equals 125.664 inches delivered by the calender roll, which is less than the number of inches delivered by the front roll. It can be seen that there must be a great deal of friction on the front roll to cause the front leather roll to lag behind to enable the calender rolls to take in all the web delivered:

125.664 divided by 129.591 equals .969 draft. No. 61.

LXII. RULES AND SUGGESTIONS.

The reader should see that metallic rolls should be used on all machines previous to the speeders. And, as stated, if the reader will refer back to the issue of the American Wool and Cotton Reporter which contains the articles of "The Well-managed Mill, and the Ill-managed Mill", he will find what we have said is true, and that such articles help many mills where the management is willing to reason. Again, we say if you have a sliver weighing over 60 grains per yard at your finished drawing, reduce it at once, even if you are compelled to install more deliveries of drawing. All mills running a light finished drawing sliver, are well repaid in after processes, for reasons we have explained elsewhere.

By what has already been said, it can be seen that the four lines of rolls are driven at a different speed. The object of this variation in the surface velocity is to procure a continuous attenuation of the sliver as it passes, and of course, the amount of attenuation depends entirely upon the ratio of variation.

Now if the above is true, and it surely is, the reader should see that when leather covered rolls are used, the proper attenuation between the calender and first roll is not obtained as when using metallic rolls; thus, it can be seen that an even strand with leather rolls is an impossibility, unless a

VERY LIGHT

sliver is run.

It is customary to have the greater part of the draft between the front and second rolls, as can be seen by referring to figured drafts. The reason for this is that the sliver is bulky and a slight draft between the first pair of rolls first acting upon the cotton compresses and flattens out the sliver, then between the second and third roll the slivers are drawn a little more, and this gradual acceleration results in the establishment of an approximately parallel order, which enables the front rolls to perform a better attenuation. An excessive draft at any point upon the sliver would be destructive to the staple. Too great a draft will cause cut drawing slivers, especially when the draft is excessive between the front roll and calender roll. In order to test if there is too much draft between the front and calender rolls, place a lead pencil under the web and raise or lower it. If the slack is taken up quickly, it indicates too much draft. This trouble is felt more in damp weather, because the fibres are more coherent and harder to draw when in this state, which causes friction on the front roll, which increases the draft at this point. On the other hand, on account of having to be drawn through a small hole in the trumpet, the least expansion will make the hole smaller, which causes the web to sag slightly.

The writer knows carders that have increased the draft between the front and calender rolls on hot summer days, on account of the

WEB SAGGING

slightly, and when the atmosphere became dry, they forgot about it, and the consequence was a cut web. If a web will sag and run all right on a drawing or card, it should not be disturbed.

In starting a room or changing over from very coarse to fine work, most carders find it difficult to find the proper drafts on each head to give the proper weight sliver at the finished drawing; therefore, we give the following rule:

RULE.

Multiply the hank drawing intended by the doublings and divide by the hank carding, extract the cube root from quotient, and the answer will be the draft that should be on each head to give the desired finished drawing. Example, 60 grains sliver desired at the finished drawing from a 50-grain card sliver: 8.33 divided by 50 equals .166 hank carding; 8.33 divided by 60 equals .138 hank or finished drawing wished. Three processes of drawing,

each delivery containing 6 doublings, 6x6x6 equals 216x.138 equals 29.808 divided by .166 equals 179.56; cube root of 179.56 equals 5.64 draft that should be on each head of drawing.

To prove the above, work it out in another way: thus, 5.64x5.64x5.64 equals 179.406144; 179.406144x.166 divided by 216 equals .138 hank drawing.

The best method to find the production on a drawing frame is to first find the constant for production, and then the production is always

EASILY FOUND.

Multiply the circumference of the front roll by the minutes the front roll is run, divide by 36 (inches) and 840. Diameter front roll 1⅜ (inches) x3.1416 equals 4.3197 circumference. 56x60 equals 3360 minutes in a week. 4.3197 x3360 equals 14514.192 divided by 36 equals 403.172 divided by 840 equals .48 constant. Now divide the hank sliver into constant, and multiply by the revolutions of the front roll and the quotient will be the production turned off one sliver 100 per cent.

Sixty grain sliver, 8.33 divided by 60 equals .138 hank sliver; .48 divided by .138 equals 3.47. Revolution of front roll 400; 3.47x400 equals 1,388 pounds in 56 hours from one sliver. Then multiply the weight turned one sliver by the total number of deliveries to get the total production. We give no per cent allowance, because the allowance made depends on the skill of the drawing tender, also the number of deliveries the tender is called on to operate, the weight of the sliver, and the speed of the front roll. When running a 60-grain sliver on all heads, however, 5 per cent is a good allowance with a good draw-in tender. No. 62.

LXIII. FURTHER SUGGESTIONS.

It should be remembered that a high speed on a drawing does not always pay. There is a limit to the capacity of a drawing frame like every other machine, beyond which the work done deteriorates or the excessive number of stoppages, through breakages and stock running out, prevents any advantage being gained by an excessively high speed. Because the operation of a drawing is simple, due to the simplicity of the different mechanisms, the drawing frame is often abused and neglected. The back of each drawing frame requires watchfulness on the part of the overseer or second hand to see that no dirt and waste accumulates between

THE SPOONS

on the mechanical stop-motion drawings, because when the spaces between the spoons are clogged with dirt and waste, and an end is light, or even when the sliver breaks, the spoon will not drop immediately, which causes single in the delivered sliver. Crossing the ends should not be allowed at the back of a drawing, because the ends will not be separated as they should be at the guide, which causes one end to ride another. On the

ELECTRIC STOP-MOTION

the dead roll should be examined often to see that no waste has gathered between it and the preventer rolls, because from what we have said, it should be seen that any cotton or waste at this point will insulate the dead roll and preventer rolls. The switch Y, Figure 22 (as shown in our issue of November 10), should be wiped and also the springs on each side of Y. The finger should be removed often and wiped, because oil, as a rule, accumulates very fast between the finger and the magnet, which makes the stopping of the frame less reliable. A good method is to wipe all the fingers every Monday morning in order to make the stopping of the frames more sensitive.

Sometimes the calender rolls are not allowed to come together, owing to the driving gears

BEING CLOGGED

up with dirt. Sometimes it is the cause of a little slackness in the bolt that holds the rolls together. The turn tables that turn the cans should also be cleaned every four weeks, because when waste accumulates under the turn tables, it gives the can an angular position, which causes much

breaking back of the sliver at the slubber, and it causes the can to fall from under the coiler, when nearly full. Electricity will give a great deal of trouble at times, especially at the tube of the coiler. When the coiler tube is cold, it offers much resistance to the passage of the slivers, which continually keep clogging up between the top of the tube and the calender rolls. Then instead of using a soft wire hook to remove the cotton collected at this point, the tenders usually use their fingers which makes matters worse.

When the tube of any coiler keeps giving resistance to the passage of the stock, the best method is to cover part of a broom handle with flannel and use whiting or graphite freely.

The stick should be worked in the tube with quick strokes in order to heat the tube as much as possible.

The flannel on the top clearer should be moved a little every month, so that the same part of the flannel will not bear on the front roll. This will save the flannel; besides, having another part of the flannel bear on the front roll, it will keep it much cleaner. Top clearers for the rolls should receive more attention than they generally do in most mills, because if the waste is allowed to accumulate, and is not removed from time to time as it should, much cleaner waste will follow the web if the hole in the trumpet is large. No. 63.

LXIV. DRAWING AND TWISTING PROCESSES.

The scheme of operations of slubbing and roving are defined as drawing and twisting processes. The slubber like the drawing frame attenuates or draws out the strands. The slubber is the first stage in the formation of the twisted thread to which the name of "roving" is given. The matter of twisting and winding the twisted strand on suitable bobbins is simply to facilitate the subsequent processes. The twist given is only sufficent to impart a certain cohesion and strength to the roving which will enable it to withstand the unwinding of itself at the next process. Evenness of roving has always been a subject of importance, and a most potent factor in the production of good yarn and cloth. Much has been said and written upon uneven roving caused by disarrangements of the preparatory machines, but too little attention has been given to a thorough understanding of the working parts of the machines.

After the sliver has been formed at the finisher drawing, it is still too bulky and must be

FURTHER ATTENUATED

by the slubber and fly frames. As this sliver has to be reduced in weight in about the proportion (for fine work) of 150 to 1, it will be seen that it would be impossible to perform this drafting by one process, and thus the cotton must pass through three or more machines. What we mean by too little attention being given to a thorough understanding of the working parts, is that most carders give very little attention to the most important parts of the slubbers and fly frames, which are the cones and connections from the bottom cone to the bobbin, and between the second (on a slubber) and first rolls. The cones and their connections which regulate the tension will be explained later.

As we have stated many times, the drawing sliver from the finisher drawing should never exceed 60 grains per yard in a print-cloth mill, and for fine work, would be too heavy; therefore, we give the following as an example. Suppose as we have pointed out in the article of the ill-managed mill that the finished drawing weighs 85 grains per yard, and it is desired to make a .57 hank slubber roving. A draft of 5.83 is the proper draft to make .57 hank from an 85-grain sliver not considering the twist per inch, and the friction between the second and first roll. Referring to Figure 24, which is a slubber draft most commonly used in most print cloth mills, we find the draft between the last and the second roll 25 divided by 23 equals 1.08. The draft between the second and first roll 5.37. 1.08x5.37

equals 5.85 total draft, or 10x100x56 divided by 40x30x8 equals 5.83 total draft.

In times past, many mill men have taken exception with the writer because he advocated a draft of six at

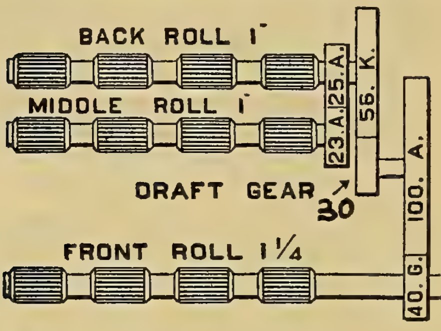


Fig. 24. Slubber Draft Gears.

each head of drawing. The writer visited some of these overseers and found a draft of 5.83

ON THE SLUBBER.

Now readers, let us reason together and let me ask if it is not more injurious to the staple to have a draft of 5.83 on the slubber than it is to have a draft of six on the drawing frame? It is possible to have a draft of six on the latest type of drawing frame and still at no point between the lines of rolls will the draft exceed three, which is always greatest between the second and third rolls, and between the other pairs seldom exceeds 1.5. It can be seen from the above that the very men that object to having a draft of six on the drawing which does not exceed 3 between the second and first roll, will have a draft of 5.83 on the slubber, which exceeds five between the second and first roll. What we have said in the articles on drawing frames should be remembered here, that an excessive draft at any point between the rolls is very injurious to the staple, especially when the sliver is bulky.

It must be admitted that the finished drawing sliver contains as many fibres in its cross-section as the carded sliver, and surely if we are wrong by advocating a draft of six amount, it must be remembered that on the drawing, it is doubly wrong to have a draft of 5.83 on the slubber. Mill men must agree that the American Wool and Cotton Reporter has pointed out one of the worst evils that ever existed in a cotton mill when it advocated not having the finished drawing heavier than 60 grains per yard. No. 64.

LXV. MISTAKES IN DRAWING

Again we ask the mill men to consider this point for their own benefit. If a sliver is drawn six by four lines of drawing rolls, and another sliver is drawn 5.83 by three lines of rolls, both having the same number of fibres in their cross-section, it can be seen that the staple in most cotton mills is injured. What we have said above can easily be proven by mill men, that are running a heavy-finished drawing sliver, by making a light carded and

FINISHED DRAWING

sliver not to exceed 60 grains. Just run only one drawing of each process for a trial and notice the difference in the compactness of the roving between the bobbin containing the roving made from an 85-grain sliver, and the roving made from a 60-grain sliver. If the above is tried, it will be found that a bulky finished drawing sliver is very detrimental to the making of an even compact strand of roving. No mill man can deny that a heavy finished drawing sliver demands more unnecessary work from the drawing rolls in after processes, which causes more frictional contact between the leather and steel front roll. A heavy sliver offers so much resistance to the top leather roll that its surface speed is unable to follow the surface speed of the steel roll, thus lagging behind and straining the strand and many times breaking it.

The friction between the first and second roll on a slubber must be double that on the drawing frame, because, besides acting on a sliver having the same number of fibres in its cross-section with only three lines of rolls and drawing the strand to almost the same

there is only one weight of 18 pounds on the front roll, while on the drawing front roll, there are two 24-pound weights, making a total of 48 pounds. Of course, many readers will consider the number of slivers that the front roll on the drawing acts upon, which is usually six. It must be remembered, however, that the diameter of the top roll on a slubber is much smaller than the drawing front roll, and that the smaller the roll, the smaller the working surface offered to the bottom steel roll. The reader must understand that we recommend a short draft at the slubber for the reasons explained; that is, that three lines of rolls are called upon to do the work that is usually done with four lines of rolls when a strand contains a large number of fibres in its cross-section. On the intermediate, a draft of 5 to 5.5 is about right, while on the fly frame and jack, a draft of 6 to 7 gives good results.

It may be asked if a draft of 5.37 between the first and second roll will

INJURE THE STAPLE

at the slubber, why it is that we advocate a draft of 6 to 7 on the fly and jack frames? We have already explained this elsewhere, but will further explain here. We have said many times that the staple is injured when the strand is bulky, because it necessitates an excessive draft, which prevents the fibres from freeing themselves owing to so many fibres being acted upon and too great a length made from one inch of strand. It can be seen from the above that the slubber is the machine that should have the shortest draft. To prove the above, if you are running a heavy-finished drawing sliver, weigh your slubber roving at doffing time and notice the variation and you will agree that the American Wool and Cotton Reporter has pointed out the worst evil existing in most mills today. No 65.

LXVI. DRAFT AT FLY FRAME.

On a fly frame, a draft of 6 or 7 is advocated, because, although the opportunity is taken in multiplying the strand by running two into one at the back, it must be understood that owing to the small number of fibres contained in the cross-section of the two strands, very little resistance is offered to the front roll. The front roll is usually weighted with a 14-pound weight, and if the strand in back has the proper turns to the inch, a maximum draft of seven will not injure the fibres if the rolls are properly set. On the other hand, if the roving fed in contains too much twist to the inch the action between the rolls will be almost like that of a bulky sliver, because the turns in the roving will prevent the fibres from freeing themselves, and if the fibres are not strong enough to stop the front roll, they are broken. Sometimes the staple is very strong, which stops the front roll and makes what is termed a hard end. The draft on a slubber should never exceed 4½, which will make .61 to .62 hank roving from a 60-grain sliver. A .62-hank slubber roving (two into one) at the intermediate calls for about 5.3 draft, for making 1.65 hank intermediate roving.

A 1.65 intermediate hank roving (two into one) at the fine speeder, calls for about 6.5 draft for making 5.5 hank roving. A 5.5 hank roving (two into one) at the rig frame for making 28s yarn calls for a draft of almost fourteen. No

ALLOWANCE IS MADE

for twist and friction, which will be explained later. The figures given are simply to show how the proper drafts can be obtained from a 60-grain sliver. By referring again to Figure 24, it can be seen that with a total daft of only 4.5 at the slubber there is still a draft of about 4.2 between the first and second rolls.

A much larger draft exists between the first and second rolls of any drawing frame of the latest type, or drawings that consist of four lines of rolls in operation in most cotton mills. We are willing to admit, that as a general rule, it is not always possible for most carders to arrange a series of slubber and fly-frames so as to give the best theoretical drafts, because

one process must keep up with another, and the carder must arrange the drafts so that the production at each process will balance that of the other, and to do this, the drafts often have to be excessive. When a carder is forced to have excessive drafts, he should acquaint the superintendent of existing conditions, and then he is blameless for the uneven work.

Some overseers when changing the drafts of different machines, are continually running to the superintendent for new gears, when at the same time if they understood how different trains of gears give the same draft, they could make the gears on hand available. The following calculation will give an idea how

ALMOST ANY GEAR

can be used by changing the train of gears to obtain any desired draft. For example, suppose that we have a 50 gear on the back roll of a machine, and a 40-draft gear meshing with the back roll, which are the only change gears on most frames, the hank roving sizing 4.40 hank and should size 4.50 hank, either the draft gear or the back roll gear must be changed.

Again, suppose that we have no gears on hand larger than 50, and the 39 gears are in use, it can be seen that it is impossible to change either gear to give a 4.5 hank roving. The first thing to do is to find the gear that will make 4.50 hank roving by proportion. We will calculate the back roll gear and we have 4.40 divided by 4.50 equals 50 divided by X from which X equals 51. To get the total draft, we multiply the back roll 51 by the crown gear 82 and the diameter of the front roll for a dividend and divide by the diameter of the back roll multiplied by the draft gear and front roll gear: 51x82x10 divided by 9x40x18 equals 6.45 draft that must be on the frame to produce 4.50 hank roving. As stated before, we are not supposed to have 51

BACK ROLL GEARS,

so we change the train of gears to obtain a new draft constant. First find a new draft constant by putting on a back roll gear that will make the gears on hand available. In this case we put on a 48-back roll gear and we have 48x82x10 divided by 9x 1x18 equals 242.96 new draft constant.

Now divide the draft required to make 4.50 hank (which is 6.45) into the new constant: 242.96 divided by 6.45 equals 37.65 or 38 draft gear. It can be seen from the above that with 38 drafts, gears that could not be used are now made available by changing the draft constant. The overseer who has charge of all the carding of a large plant may simplify his work by having a chart of draft constants and draft gears or twist constants and twist gears, so that when gears are changed the chart can be changed accordingly, and the draft and twist per inch is always known on every machine. Such a chart will be shown when we give the lay-out of the coarse, medium and fine goods mills. No. 66.

LXVII. OBJECT OF FRAMES.

All machines classed under the head of fly-frames are practically of the same type of construction. The only difference is that the slubber has no creels, besides the machines, from the slubber to the fine speeders, in certain parts are made smaller, which is necessary, in order to accommodate the decreasing size of the bobbin. The first machine is known as the slubber, the second as the intermediate and the third (when running very fine work) as the second intermediate, the fourth as the fine speeder, and the fifth as the jack frame. The objects of fly-frames are (1) the evening of the strand fed in, which is accomplished by doubling; (2) the reduction of the thickness of the strand, which is accomplished by roll drafting as was explained elsewhere; (3) the twisting of the strand, which is accomplished by the spindle being made to revolve at a greater number of turns than inches delivered by the front roll, and (4) the winding of the roving on a bobbin, which is accomplished on the

LATEST TYPE SPEEDERS,

by having the surface speed of the

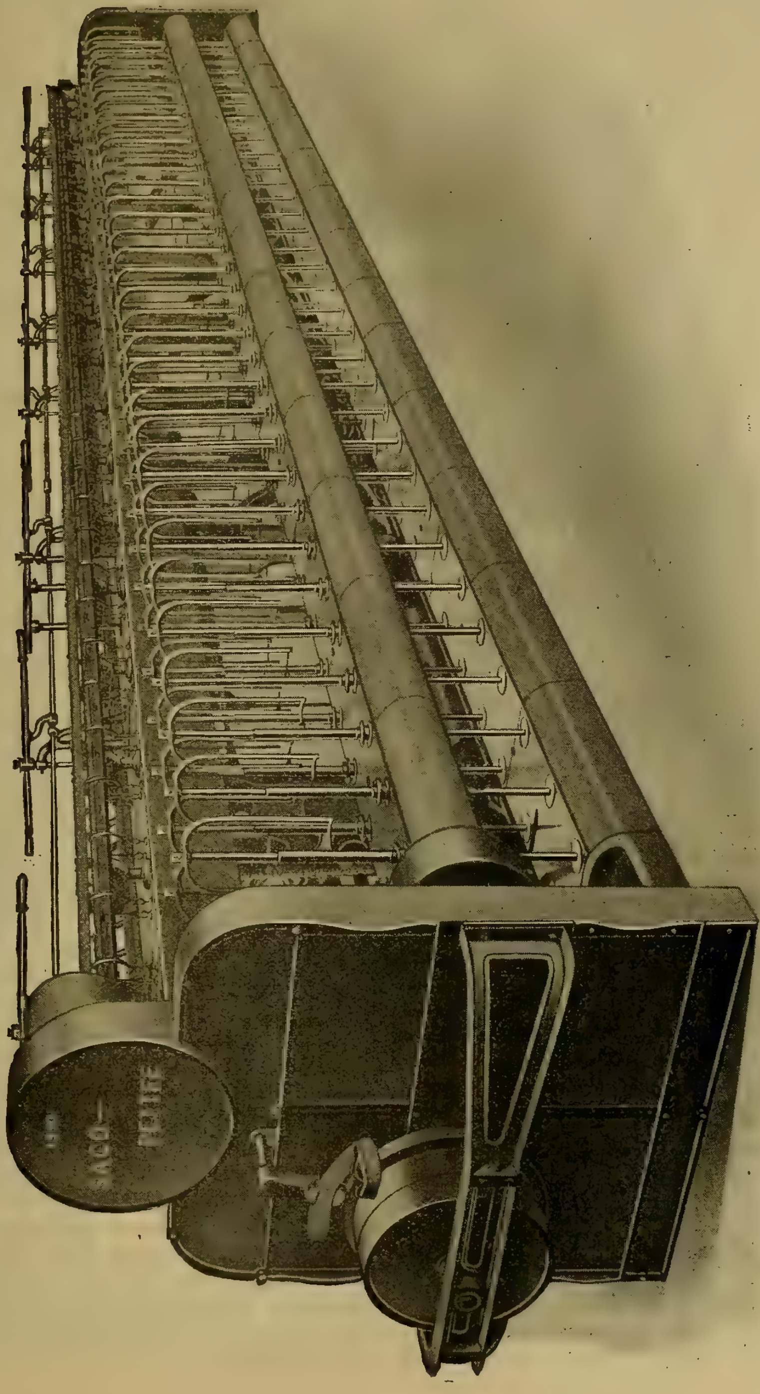


Fig. 25. Front View of Slubber.

bobbin exceed the speed of the flyer in the same proportion as the stock is delivered by the front roll at all times.

Figure 25 shows a front view of a slubber, while Figure 26 shows the front view of a fly frame. The drawing rolls of a slubber may be either of the common type or metallic, and from what has been said it should be seen that a slubber should be equipped with metallic rolls when the drawing sliver exceeds 60 grains.

From the drawing rolls, the sliver passes to the flyer, which can plainly be seen in Figures 25 and 26. The flyer consists of a boss that contains a hollow portion for the reception of the spindle top, two legs, one solid and the other hollow, in which the sliver passes, and also to which the presser finger is attached. The solid serves only to balance the other leg, and also flyer, which prevents it from shaking. The top of the boss is made smooth, and contains a hole on each side in which the strand is passed to the hollow leg, and to the presser finger. The presser finger has its inner part flattened and a guide eye is cut into the palm. The presser is attached to the hollow leg in such a manner that when the spindle revolves at a high rate of speed, the finger will hug the bobbin. The horizontal part, that is, the finger of the presser, is of such a length that the guide eye cut into the palm always comes about opposite the centre of the bobbin at the beginning of the bobbin or set. From what has been said, it can be seen that the strand is first passed through the top hole through the hole on one side of the boss to the hollow leg, then from the bottom of the hollow leg wound around the presser finger twice and then inserted in the eye. As there are different types of flyers, an explanation of their advantages and disadvantages will follow. No. 67.

LXVIII. FLYERS.

Although there are many types of flyers, it must be understood that they are all carefully constructed of such a quality of material as will take and maintain a high polish, so that the parts of the flyer over which the cotton passes will be perfectly smooth. When the hollow leg of a flyer is roughened either by not being smooth or by contracting a little rust caused in some mills where humidifiers are run when they should be stopped, there is a tendency to develop friction as the roving passes down the hollow leg of the flyer. The flyer mostly used is called the Bodden flyer, which is the type described at the beginning of this article.

As we have said, the centrifugal force causes the finger to exert a slight continuous pressure on the bobbin. This is accomplished on the Bodden flyer by having the excess weight of the vertical rod, which is cast with the finger, a greater distance from the spindle than any other part of the flyer, which is sufficient to overcome the centrifugal force of the finger, and the finger constantly hugs the bobbin. Of late, many mill men have discarded the Bodden flyer, and they are now using a new type called "drop" presser, shown in Figure 29.

It is claimed for this new flyer that where it is employed a longer bobbin can be used, and that the longer the shown in Figure 29.

MAY BE WOUND

thereon, and the larger the full bobbin, the more economically can it be used in making yarn and cloth. Some mills, in order to make a longer bobbin, have had a new drop presser attached to their old flyers.

It is also claimed that by having the arm carrying the finger bent, so as to enable the finger to travel in a considerably lower horizontal plane than the lower end of the hollow leg, that a thread rest is formed which lessens the sharpness of the bend in the roving, so that the friction on the roving is decreased as it leaves the hollow leg on its way to the hole in the pad or finger. Again, it is claimed that by decreasing the bend or angle in the roving, being drawn from the end of the hollow leg to the flyer head by bending the hollow leg to a less extent over the lower end of said hollow leg, reduces the friction of said roving

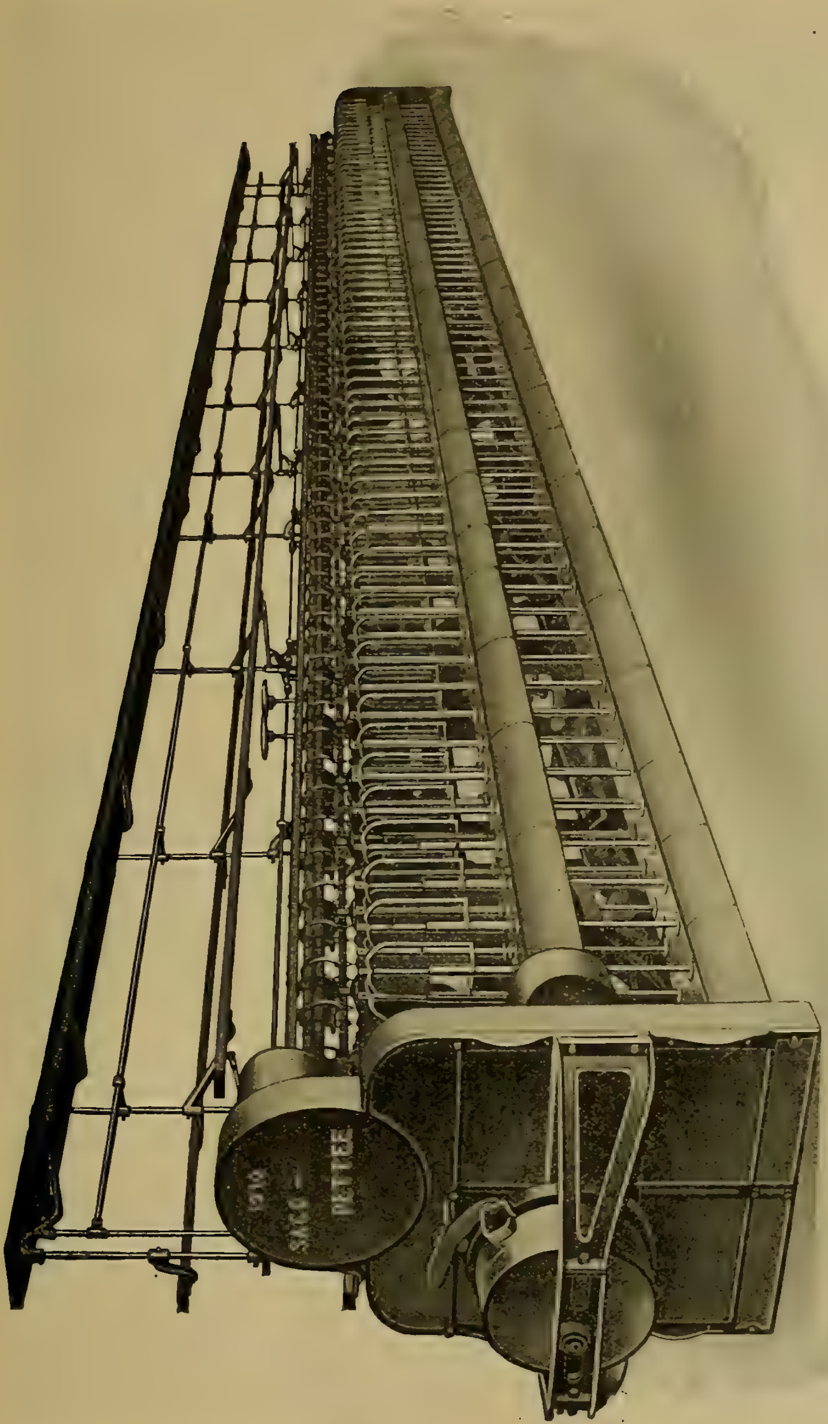


Fig. 26. Front View of Fly Frame.

on the usual sharp corner at the lower end of the leg. Again, it is claimed that it reduces the tendency of the roving to fly outwards and thus escape the threading slot of the hollow leg of the flyer. In considering the first claim, it must be remembered that if

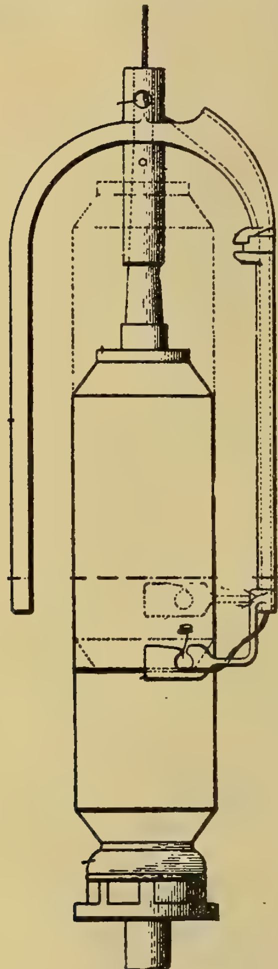


Fig. 29. Drop Presser Flyer.

the weight of a bobbin is increased by winding on more stock, that more twist to the inch must be inserted in order to unwind it at the next process without breaking, that is, if the strand contains the same

NUMBER OF FIBRES

in its cross-section. With the drop presser flyer not only the increased weight must be overcome, but the angle of draw is more acute in the spinning creel, being made so by the increased length of the bobbins. A greater strain is, therefore, placed upon the roving when the bobbins have become unwound to say from a third to the empty bobbin. It can be seen from the above that the front roll speed must be decreased, which decreases the production correspondingly, and what is gained by making a longer bobbin is lost in the speed of the front roll. The second claim is wrong, both in practice and theory, to reduce the friction between the lower end of the hollow leg of the flyer and the finger, because in most all cotton mills to date the end is wound around the arm twice before it is inserted into the eye of the finger, which is the proper thing to do. The reason that the strand is wound around twice is to increase that which the drop press flyer decreases; that is, to increase the friction between the lower end of the hollow leg and the finger, which is necessary to form a compact roving.

The next claim is that the bend of the hollow leg at the head of the flyer is lessened, and as the curve is lessened, the friction is lessened at the sharp turn at the bottom of the hollow leg.

Now, if the friction is lessened at the head of the flyer, and also at the bottom of the flyer, how is it possible to make the claim that the roving does not have the same tendency to fly outwards? Because it should be seen that the more friction at the head of the flyer and also at the bottom is going to make the strand hug

THE INNER SIDE

of the hollow leg. On the other hand, it should be seen that the less friction at each end of the hollow leg, the more freedom the strand has to vibrate inside the hollow leg, and at times escape the threading slot of the flyer. Again, it should be seen that in order to construct a compact bobbin there must be a certain amount of resistance offered to the passage of the strand in order to create a pull so that each coil will be laid as close as possible to the previous coil on the bobbin. Now, to do this, the friction upon the strand

must be applied at the proper place, a feature that the drop presser flyer eliminates entirely, because if the friction is removed from every part of the flyer that comes in contact with the strand, it should be seen that the pull is then between the bite of the front roll and the eye in the presser finger. Again it should be seen that when the pull has such a field the strand is liable to be only strained, and owing to the lack of friction at the bottom of the flyer, the strained part of the strand is wound on the bobbin and afterwards run through the spinning and spooling, and the real trouble is felt on the warper owing to the stretching field found on all warpers on account of the spools being a great distance from the beam.

No. 68.

LXIX. THE DUNN FLYER.

The Bodden flyer shown in Figure 27 is so constructed that a quarter circle bend is formed at the head of the flyer so that the pull at the bottom of the hollow leg will make the strand hug the inner side of the hollow leg if the proper tension on the frame is maintained. At the bottom of the hollow leg is found more friction or pull, which again causes the strand to hug the lower end of the hollow leg. Thus, it can be seen that friction is necessary in order that the strand will not escape the threading slot of the flyer. As stated, the strand is wound around the arm twice before it is inserted in the eye of the pad or finger.

By winding the strand around the arm twice, friction is caused which creates a pull between the surface of the bobbin and the eye of the presser and causes a slight, continuous pressure on the surface of the bobbin which lays the last coil from the front roll close to the previous coils. This necessary friction between the lower end of the hollow leg of the flyer to cause a pull between the surface of the bobbin and the pad led to the invention of another type shown in Figure 28, which is known as the Dunn flyer. This type of flyer, which is the latest, is so constructed that instead of having two legs it consists of what may be termed two wings, one wing being solid to balance the other wing which is hollow and contains a threading slot and also

Fig. 27. Bodden Flyer.

carries a presser that is fulcrumed at the lower end of the hollow wing and

FREE TO SWING

thereon, so that its position can be increased outwardly as the diameter increases. By referring to Figure 28, it should be seen that this type of flyer does not occupy the space that other types occupy, owing to its peculiar construction, and the space occupied by the two legs of other types is filled with coils of roving on this new type. The reader's attention is called to the comparison of the number of ounces of stock possible to be wound on this new type, and the number possible to be wound on other types. On a flyer 11 by 5½, of the new type, 65 ounces of combed stock is possible to be wound on the bobbin, while on other types, the largest bobbin that can be made with the same gauge flyer is 38 ounces. Of course, the reader must understand that sometimes more ounces than given above can be wound on the bobbin and sometimes less, because spongy cotton will increase the diameter of the bobbin with less stock, while on the other hand, wiry stock will make the strand

harder and the weight of the bobbin is increased with a much

LESS DIAMETER.

occupied by spongy cotton weighing much less.

It would be thought that what was said about a larger bobbin made by the drop presser flyer holds good here; that is, the heavier the bobbin

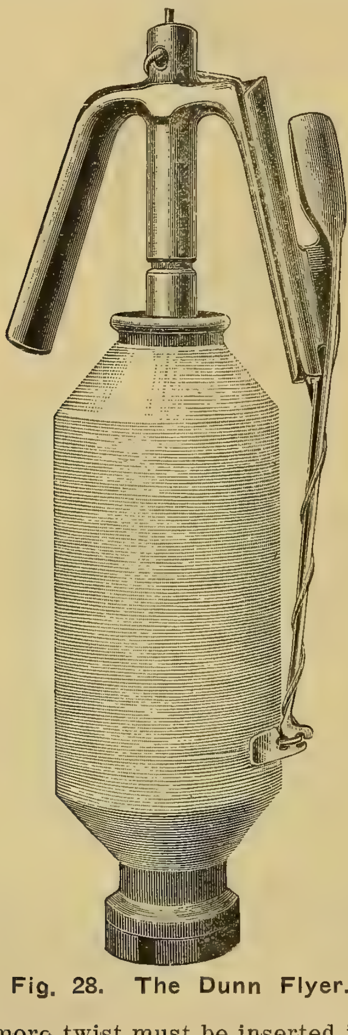


Fig. 28. The Dunn Flyer.

the more twist must be inserted in the strand in order to unwind itself at the next process. This is not true with the Dunn flyer bobbin. The bobbin is increased in diameter which gives an increased leverage, which aids in turning the bobbin, and it is found by actual tests, that twist does not have to be inserted.

As we said before, the advantage of having the friction at the proper place led to the invention of the Dunn flyer, because, by referring to Figure 28, it can be seen that the presser serves as a leg, and that the presser foot is made to press upon the surface of the bobbin by the centrifugal force that tends to make the weighted upper part of the presser fly outwardly. Thus, it can be seen that the distance between the foot of the presser and the surface of the bobbin is much less than the length of any staple. Again, it should be seen that wherever the strand comes in contact with the flyer before it reaches the foot, it simply receives a support, without drag.

It should be seen from the above that the improvement that makes this new type of flyer possible to wind almost twice as much stock as can be done on other types is that the friction upon the strand is in only one place (See Figure 28B), and that is where the distance is shorter than any staple that can be used. So it can be seen that much tension can be maintained at the proper place without injury to the strand, which enables it to lay the coils closer to one another, and a much larger number of coils are laid on the bobbin with the same gauge than is possible on other types of flyers.

There is one claim, however, made for the Dunn flyer that is hard for manufacturers to understand, viz.: That with the Dunn flyer a better quality of goods is obtained, and it must be remembered that the Bodden flyer does not injure the stock, but if the principle of the Dunn is studied carefully, it will be seen that it is possible to produce a very much evener roving. This is owing to the feature before mentioned of the friction being applied at one place and that, next to the bobbin and within the length of the staple being run. That is the feature that is making this new type so popular, as a firm bobbin is constructed unequaled by any other type, with an

easy tension above the foot of the presser.

We have noticed of late that many writers claim that in order to use the Dunn flyer successfully, the cones would serve for all kinds of flyers, and we have been led to believe thi is a truism, because one type of flyer has been in use for so many years that it has been accepted as the

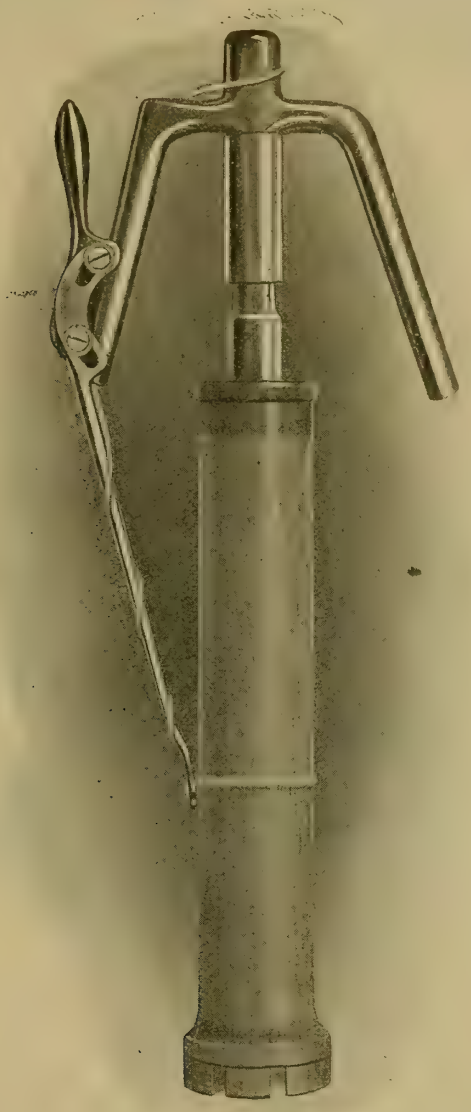


Fig. 28A. A Dunn Flyer with Empty Bobbin.

must have a different outline. At first, one would think that this is erroneous, because cones that have a true outline to obtain the intermediate speeds, standard. But there is a difference even in the same type of flyer, as no two builders make them exactly alike, even if they look alike, and

flyers built by different flyer makers of the same type will not run successfully together upon the same frame in many cases.

The reason for a

DIFFERENT OUTLINE

of cone, when the Dunn flyer is used is, that the pressure of the presser tube, to the bobbin. As the bobbin fills up, this angle changes from acute to nothing, so that when the bobbin is full the presser leg is nearly perpendicular; this changing of position does not in any way affect the support of the strand, or the friction on the strand as it passes through the two eyes of the presser foot;

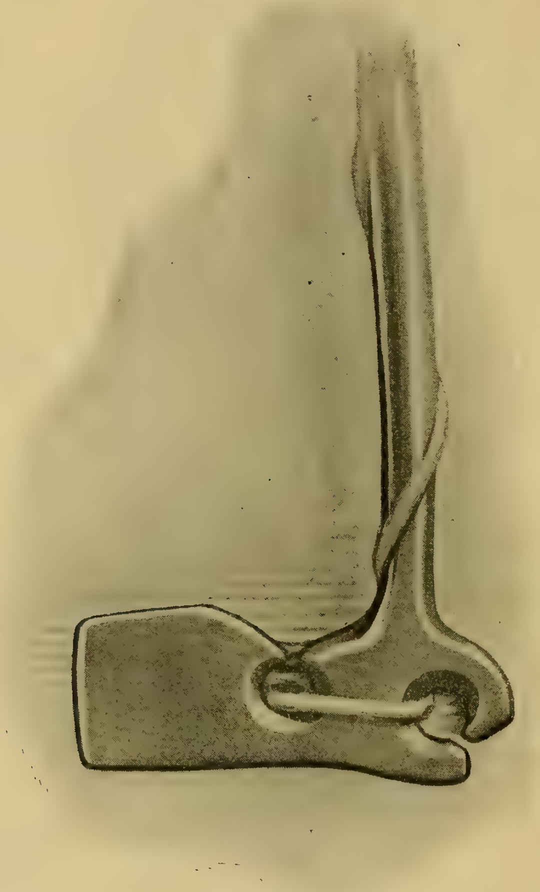


Fig. 28B. Dunn Flyer Presser Foot.

foot is greater upon the empty bobbin than it is upon a full one. This same feature occurs in all types of flyers, but is more more marked in the Dunn flyer.

In looking at Figure 28A, it will be seen that when the bobbin is empty, the presser leg is at an angle, from the joint upon the end of the hollow thus the tension remains the same throughout the building of a bobbin. This tension, as said before, and as shown in Figure 28B, is the feature of the Dunn flyer, as it serves to make a firm bobbin with the tension applied at the proper place.

In referring to Figure 28 A again, it will be seen that while the presser

foot is upon the empty bobbin that part of the presser that is above the joint is far out, and at its extreme distance from the centre of the spindle; therefore, when the frame is started at speed, the centrifugal force is exerted at its maximum, which creates considerable pressure upon the condensed strand. As the bobbin fills up this pressure decreases until the presser leg has reached a perpendicular position, at which point the pressure is nil.

It is this

VARYING PRESSURE

upon the strand that calls for a different outline on Dunn cones.

This pressure acting in addition to the natural draw of the flyer produces a very firm and compact bobbin with a good foundation upon which to build subsequent layers. This pressure reduces the thickness of the layers when the bobbin is small, so that more layers are needed to make a given diameter of bobbin than with any other kind of flyer. When the bobbin is most full the pressure being decreased, as it should be, the number of layers corresponds very nearly with those that other types of flyers lay on.

All writers upon cones leave the reader to assume that the diameter of the strand is the same from an empty to a full bobbin. They are right, for the diameter does not change, but the pressure of the presser foot does reduce the thickness of the layers, so that the bobbin does not increase in diameter in the proportion that we are lead to believe.

To assume that the thicknesses of the layers are the same at both an empty and a full bobbin is necessary when starting to lay out a pair of cones; in doing so, we will then get an approximate outline. To get the true outline, a bobbin of roving must be considered layer by layer, and the cones as a continuous string of separate pairs of pulleys, one pair to be used for each separate layer upon the bobbin. However, this will be explained more fully later.

No. 69.

LXX. CARE OF FLYERS.

The boss of the flyer is tapered and has a wire pin fitted into holes bored in the sides of the flyer. The spindle is also tapered and a slot is cut in its upper end that is made to fit the wire pin in the boss of the flyer.

When the pin in the boss of the flyer is worn or the slot in the top of the spindle, the flyer is free to turn slightly. This slight movement of the flyer causes the flyer to work itself up, and when the carriage is working up, it will in most cases work the flyer still higher on the top of the spindle.

This will cause the flyer to vibrate and as the gauge on most all speeders is narrow the flyer is struck by the other revolving flyers, and in most cases it will fall among the other revolving flyers, with the result that it is broken besides breaking the other flyers. The real cause of the flyers coming off and falling among other flyers in most mills is mostly due to the dryness of the spindle top and the boss of the flyer.

In some cases it will be found that the spindle tops have contracted rust, As the flyers have to be removed at every doff it can be seen that if the spindle tops do not receive

PROPER CARE

the pulling off of the flyer so often will wear the inner side of the boss, the spindle top, and also the pin in the boss of the flyer. It should be seen that in a short time the surface of the spindle top and the inner side of the boss becomes uneven, causing vibration, with the result that the flyer will work its way to the top of the spindle and fall among other flyers as was explained. All flyers in a cotton mill should be swabbed out every four weeks and the spindle tops should be oiled every Monday morning. It is a very small matter to have a speeder tender raise the flyers off the back row of spindles and add a little oil at the first doff every Monday morning. Once the above system is put into practice, it will be found that the flyer bill will be greatly reduced, and the spindle tops always in good condition and free from rust.

One good point we want to give when a flyer bothers by continually working its way up on the end of the spindle, is to remove the pin in the boss that will be found slightly worn and fit another pin in its place that will fit the slot in the top of the spindle if it is also slightly worn. Another bad practice found in many mills is in spreading the legs of the flyers in order to increase the diameter of the bobbin. In most cases it does not pay, because the presser rods strike one another, owing to their position being at a greater distance from the centre of the spindle, with the result that they are in most cases detached, and they too fall among other revolving flyers and many are broken. No. 70.

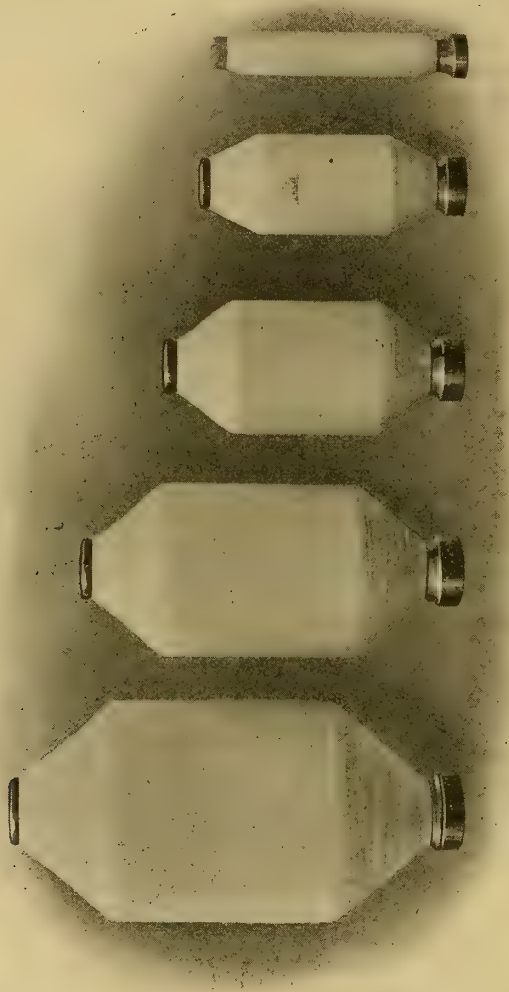


Illustration of the Product of Flyers.

LXXI. SPINNING ROOM TROUBLE.

The footstep in which the spindle rests is often neglected in many mills. They are generally oiled once a month, but often many spindle steps do not receive any oil once in two months.

To prove what we say here needs only the visit to some cotton mill that has been running ten to twenty years, and if the spindle steps have been neglected, the spindles on each frame will, in most cases, all have a different height. When spindles have a different height, it becomes almost impossible to make a traverse of a proper length, without bending the pressers up or down. When the spindle steps are in such a condition, and it is impossible to make a long traverse, the best thing to do is to line up the spindles. This is done by using washers which may be made with a belt punch the same diameter as the hole in the footstep for the reception of the spindle. Cut leather washers and insert them in the footstep until the spindle is the same height as the highest spindle. There is much to be gained by making the spindles all one height, because this makes a long traverse possible. A long traverse means less doffing and less creeling in the next process, and

LESS CREELING

means less waste, because a certain amount of roving is generally pulled off. There are various types of footsteps, some are just bored to receive the spindle, while others have holes drilled through partitions between reservoir and bearing, so that oil entering the bottom of the bearing is siphoned back into the reservoir through the top. It is claimed for this new spindle step that the only loss of oil is that caused by wearing out and evaporation, which, it is claimed, is very slight. Some types of steps have a hook cast that fits over the teeth of the spindle gear. The object of this hook is to prevent the spindle from raising when the flyer is pulled off at doffing time.

There is no doubt that such a device does save the wood casings of the speeder, but on the other hand, it is the cause of many fires that offset the first advantage. All practical mill men know that when a bobbin is badly built and the upper coils protrude to the spindle and are wound thereon, no harm will result if the rail is going down. On the other hand, if the rail is making its upward movement, and the coils are wound tightly around the spindle and the spindle is held in place by the hook, it can be seen that the upward movement of the rail forces the top of the bobbin on the coils, and as the bobbin is made of wood and the coils composed of cotton,

THE BOBBIN REVOLVING,

at a greater speed will result in much friction, which in most cases causes fire. We have a mill in mind where such fires occurred so frequently that the superintendent ordered all hooks on the footsteps broken off.

The bolster that supports the spindle in a vertical position requires a little attention, because if it is not cleaned once every year the dirt that will collect in that period, combined with the speed of the spindle, will cause the spindle and bolster to heat. When several spindles are heated, the spindles and bolsters expand and much resistance is offered to the revolving spindles, in addition to that offered to the bobbin rail when making its downward movement. Sometimes some spindles get heated to such an extent that the bolster must be removed from the frame in order to extract the spindle from the bolster. The carriage or bobbin rail is run by the cone belt, and any unnecessary strain upon the carriage acts correspondingly on the cone belt, and any resistance offered to the cone belt means a slack and irregular tension which makes the work run badly. All bolsters on all speeders in a cotton mill should be scraped and cleaned at least once every year.

Besides removing much

UNNECESSARY WORK

from the cone belt, it will be found that very few skew and bobbin gears will be broken. Here is another defect we wish to point out to mill men, and that is the putting on of split skew gears in the place of a broken gear. We have seen as many as fifty split skew gears on the bobbin gear shafts. Of course, when a split skew gear is put on the spindle shaft, the resistance is offered to the driving belt, but with a large number of split skew gears weighing almost double

the weight of a single piece skew gear, it can be seen that much resistance is offered to the cone belt, which affects the tension. The bobbin that fits the bolster should be of the same diameter as the other bobbin on the frame. When ordering bobbins, a bobbin gear should be sent to the bobbin shop with a bobbin that fits the bobbin gear and bolster and the bobbin should be of a proper diameter. Bobbins having a different diameter cause a great loss in production, because the surface speed of the front roll and the excess surface speed of the bobbin over the flyer should be equal, and if bobbins of different diameters are used, the relationship of the surface speed of the front roll is destroyed on all bobbins not having a proper diameter, thus causing some ends to become too tight, or too slack, making waste, because the layers on such bobbins are cut off, besides losing production. The inside of a bobbin should touch the bolster slightly, because if the bolster fits the bobbin tightly it will continually raise on the bolster and give much trouble. To prove the above, insert a little waste inside of a bobbin and it will be found that as soon as it revolves it will raise on the spindle. No. 71.

LXXII. STAPLE AND TWIST.

We have explained how the drag or friction on a flyer will make a hard bobbin. But it must be understood that the strand that forms the coils in the above explanation is supposed to contain the proper amount of turns to the inch. No matter how much the finger is caused to press on the surface of the bobbin, if the strand which forms the coils does not have the proper turns to the inch the bobbin will be soft. The amount of twist that should be inserted in a certain hank roving is an important consideration, and it is something that cannot be learned from a book or textile school. The proper amount of twist that should be inserted in roving or yarn is obtained only by experience, judgment and diligent study.

We like to see a carder that will sample a bale in the mixing room and tell us whether it will lose twist or gain twist. Such a carder is worth his weight in gold to a plant, because if he can judge the number of turns to the inch that should be inserted for different mixings, he will turn off a larger and better production. For instance, let us suppose that one

MIXING IS COMPOSED

of wiry cotton which requires less turns to the inch than fluffy cotton, which has few convolutions, and that it is run through without changing the twist per inch. The roving will be too hard again when put up at the next process, the fibres cannot free themselves so easily, and many are injured. We have explained elsewhere how a long staple or a strand containing too much twist to the inch will cause many hard ends, owing to the construction of the fibre or strand offering too much resistance to the front roll. On the other hand, in the above case, if the carder changes the twist gear to increase the speed of the front roll, a strand consisting of a better drawing quality is produced, besides increasing the production. Hard ends should be eliminated as much as possible, because on a speeder one hard end will sweep down a dozen other ends, and they are the cause of many fires in the picker room.

When the cotton is fluffy, it will act opposite to the above, and more twist should be inserted in the roving. This is where a good carder again proves his worth by inserting the twist in time to save breaking back in the next process. In some mills, the twist gears are not changed once a year, and the overseers in those mills think it is to their credit. It should be seen that twist suitable for June would not be suitable for August, or vice versa. So, in order to suit the atmospheric condition, we change the twist gears. Besides the atmospheric condition, the

CONSTRUCTION AND LENGTH

of the staple should be considered, as was explained elsewhere.

It will be seen that the twist should be changed often, sometimes for each mixing. But in the majority of mills, the twist gears are changed twice a

year, thus inserting more twist in the roving in summer than in winter. Practical men will agree with the writer that, in most mills, the twist is only changed twice a year, which is the proper thing to do, because we are willing to admit that more twist should be inserted in the roving in summer and less in winter, but there is no reason why a carder should not feel of his roving every day, and if it is found hard, have the twist gears changed. Of course, twist is not the only cause for a hard bobbin, for when the work becomes very heavy, it will cause hard bobbins too. The reason for this is that when the strand is heavy it contains more fibres in its cross-section, and, of course, all practical men know that the more fibres a strand contains in its cross-section, the less twist to the inch should be inserted. In such cases as above, it can be seen that the diameter of the strand is increased, and the twist per inch, by remaining the same, causes the strand to become harder.

The strand, besides being harder, is of a larger diameter, and this makes the diameter of the bobbin larger, which makes the

SURFACE SPEED

of the bobbin slightly greater than the surface speed of the front roll. It should be seen that when the surface speed of the bobbin is slightly greater than the surface speed of the front roll, a pull on the strand always exists, which makes a hard bobbin even though the proper turns are inserted in the strand. In considering the twist per inch, it should be understood that the strand is gripped by the bottom steel roll and the top leather roll as it is being delivered, and is also held by the bobbin on which it is wound. The amount of twist in the roving depends on the relation that the speed of the spindle bears to that of the front roll. In order to fully understand how the twist is inserted into the roving, the reader must fix firmly in his mind that the rolls are constantly delivering roving and the bobbins taking it on its surface as fast as it is delivered. So it can be seen that while the roving that is being twisted at one time is in a suitable position to receive the twist, and as a new supply is constantly being brought under the twisting operation at a regular and uniform rate of speed, the portion which has been twisted is also constantly passing from the influence of the twisting operation and on to the bobbin.

No. 72.

LXXIII. TWIST CALCULATIONS.

From the above, it can be seen that the twist is increased by decreasing the speed of the front roll, or the twist decreased by increasing the speed of the front roll. Again it should be seen from the above that the twist per inch may be found by obtaining the data as to the number of inches of roving delivered by the front rolls during a certain period, and the number of turns made by the spindle during the same period. If, for example, the flyer makes 75 turns while the rolls deliver 25 inches of roving, then we have 3 turns to the inch; thus, 75 divided by 25 equals 3 turns.

Another method in finding the turns per inch being inserted in the roving is to obtain the twist constant by the arrangement of gears from the circumference of the front roll to the spindle gear, calling the twist gear 1. Example: the front roll is 1.25 inches in diameter, front roll gear 130 teeth, gear on end of top cone shaft 44, top cone gear 56 teeth, jack shaft gear 40 teeth, spindle shaft gear 37 teeth, gear on spindle shaft driving spindle 55 teeth, gear on spindle 22 teeth. 130x56x40x55 divided by 44x1x37x22 equals 447.174; 447.174 divided by 1.25x3.1416 equals 113.87, twist constant.

We give the above calculation which is the best method, because after the constant has been found it is an easy matter to find the twist per inch. To find the twist per inch, divide the twist gear into the twist constant, and to obtain the twist gear divide the twist per inch into the twist constant.

Many tables are given for an approximate idea, and many overseers believe such tables to be exact, and they make their changes accordingly,

and if the roving breaks back at the next process, they will simply

TELL THE SPINNER

that they have the right number of turns to the inch, and let it go at that. The constants most commonly used for one inch American cotton are 1 for slubber, 1.1 for intermediate, 1.2 for fine speeders and 1.3 for jacks. Of course, 1.3 is given for jacks, because, as a rule, a much finer hank roving is made on the jacks, but if the same hank is made on both machines the same constant should be used. We will now give a practical example that is used every day in most cotton mills. Suppose we are called upon to make a five-hank roving, what turns to the inch should we have in the roving, also what twist gear will give us the necessary number of turns to the inch, using the above twist constant?

First, find the square root of fine hank roving which is usually made on fine speeders and multiply the square root by the constant which is 1.2. Example: The square 5 equals 2.23x 1.2 equals 2.676, or 2.68 turns per inch; 113.871 divided by 2.68 equals 42 twist gear. The above rule is used when starting a new mill, but when the hank roving is known, the following is usually employed. Suppose we are changing a frame from four-hank roving to five-hank roving with a 30 twist gear on the frame. Example: 30x30 equals 900x4 equals 3600 divided by 5

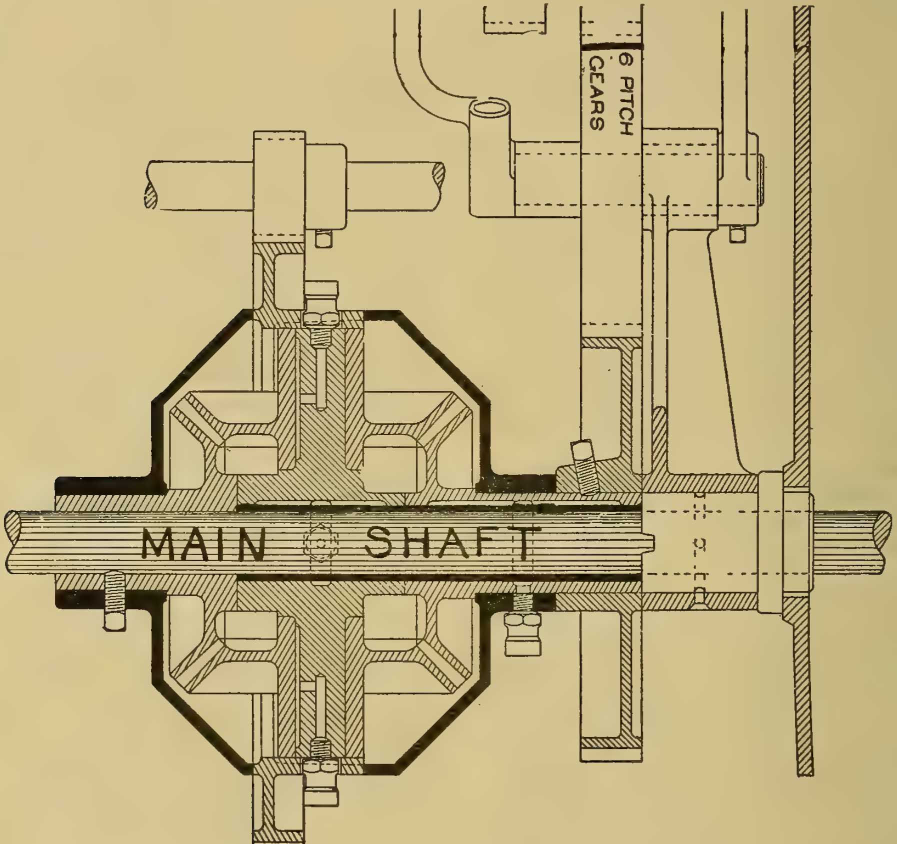


Fig. 29B. The Improved Houldsworth Differential Motion.

equals the square root of 720, equals 26.83 or 27 gear. The above is

AN OLD WAY,

and for the benefit of those who can not use the square root, we offer the following example which is shorter and just as accurate: 30x4 divided by 5 equals 24, twist gear, added to 24 plus 30 equals 54 divided by 2 equals 27 gear.

As stated above, the constants given are used simply for an approximate idea in making the first set. When the frame has made a full set, a good test for determining whether a sufficient number of turns per inch are being inserted in the roving is to feel of each bobbin to see whether it is too hard or too soft. But what was said about the other conditions must be remembered, that is, about the work being uneven, caused by the rolls not being set properly, running a very heavy sliver, excessive drafts, etc. Having too much twist in the roving is detrimental to the spinning, making the work run badly, besides spoiling many top leather rolls.

Having too much twist in the roving is very costly, especially in a cotton mill that has only enough fine speeder spindles to run the spinning. As was pointed out, in order to insert twist in the roving the front roll speed must be decreased, and this, of course, decreases the production on the fine speeders; consequently, the back work accumulates, which necessitates the stopping of the processes operated by the day help. From what has been said, it should be seen that in order to be a good carder, produce good work, and at the same time turn off as large a production as is consistant with the quality of the work required, keeping down the expenses of wages, power, etc., requires eternal vigilance to the construction of the fibre and also the strand. No. 73.

LXXIV. EARLY SPINNING PROBLEMS.

As most mill men know the front roll of a speeder rotates at a constant rate of speed, hence, a uniform length of roving is being constantly delivered. With the bobbin, it is different, as its rotation is changed at every completion of the traverse. To do this, suitable means must be employed for winding the roving on the bobbin, and at the same time, the action of the mechanism for winding must be such that the roving will not be strained or broken.

This is the very problem that confronted Mr. Greene in the year 1823, when he was working to connect the spindle and bobbin together. It was soon discovered by Mr. Greene, and Mr. Houldsworth that, in order to accomplish perfect winding, two mechanisms acting in combination were necessary, namely, the cones and the differential motion.

Mr. Greene first connected the spindles and bobbin together in the year 1823, but owing to the shape of the cones at that time, and the lack of a differential motion, his years of hard work were a failure.

Mr. Houldsworth was

ALSO AT WORK,

but instead of working on the combination of mechanisms invented at that time, he concentrated all his work upon a mechanism that could be made up of two speeds. Because he realized that if the winding-on arrangement had to be made up of two mechanisms acting in combination, one of the two had to be made up of two speeds. So after working for many years, Mr. Houldsworth gave us the differential motion in the year 1826, which has never been improved excepting by a change which reduces the friction between the driving shaft and differential sleeve. This is accomplished by the use of a shell or bushing inserted between the sleeve and shaft. This was done in 1897 by Fay Martin. Figure 29B shows this improved Houldsworth differetial motion, or bevel gear compound as it is more commonly called. The bushing for the reduction of the friction between the sleeve gear and the main shaft is shown by the heavy black lines next to the main shaft. This bushing does not revolve, but is

fastened in such a way that the main shaft is free to revolve on the inside while the sleeve gear revolves free upon the outside; and these in opposite directions without touching each other. The differential motions will be explained later. When Mr. Houldsworth gave us his wonderful invention, it was an incentive to other inventors, because more inventors have worked on the differential motion than on any other device, and by so many of them working on the differential motion, many other improvements were discovered which were a great help to the combination of these two mechanisms. One of these great improvements was the introduction of the cones which have replaced the old unequal racks used previously for many years. As we said before, after years of hard work and study, it was found that if a bobbin increased in diameter from one inch to one and one-eighth inches, the proportionate increase was one-ninth part of the total, but if the bobbin increased from three and seven-eighths inches to four inches, the proportionate increase was only one-thirty-second part of the total diameter.

So it was clearly realized that the equal increase of one-eighth of an inch in diameter of the bobbin was only equal in addition, and was very unequal in proportion. To obtain the intermediate speeds,

THE CONES

were considered as a continuous string of pulleys connected together, and in finding their true outline, each layer added to the bobbin or roving was considered separately, and the diameter of the cones figured for that layer alone, and the result was a concave upper cone and a convex bottom cone, which gave the cones their peculiar formation—the most essential feature of the cotton roving frame. The cones will be more fully explained later. It was only a few years ago, that the common practice on all fly frames was for the flyer to lead the bobbin, and was known as the flyer lead. It was soon found, however, that this system had two defects: (1). the bottom cone had its slowest speed when the bobbin was empty and its greatest speed when nearly full or filled, the bottom cone constantly and uniformly increasing in the number of revolutions per minute between these two extremes; (2), the flyer started in advance of the bobbin, and by so doing made a weak place in the roving. Regarding the first defect it will be seen later that on the bobbin lead the speed at the commencing and ending of the set is contrary to that of the flyer lead; that is, by the speed of the bobbin being greater than that of the flyer, the bobbin rotates at its greatest speed when empty, and at its lowest speed when full. It should be seen in such a case as referred to above that as the bobbin grows larger in diameter and heavier, the bottom cone decreases in the number of revolutions at every completion of the traverse, thus making the consumption of power more uniform. As regards the second defect, which was very much misunderstood

FOR MANY YEARS,

at that time the slipping of the cone belt was given as the reason for the weak places in the roving. Others claimed that owing to the flyer starting first, and the velocities of the bobbins and spindles at the instant of starting not being in the required ratio, weak places were caused in the roving. If the actual number of gears connecting the bobbins and cones and the number of gears from the driving shaft to the spindle are considered, it will be found when using the Houldsworth differential motion, that the actual number of gears in the train to the bobbin is nine, and from the driving shaft to the spindle five. From the above it should be seen that the cause of the flyer starting before the bobbin, is owing to the back lash, which is more in the nine gears than in the train of five gears. So, as stated, in order to remedy these two defects, the system was altered and the bobbin was made to lead. No. 74.

LXXV. BOBBIN AND FLYER LEADS.

The following instructions we think will be found both interesting and instructive, and in order to fully understand our meaning, the reader must not forget what was said about one mechanism being made up of two parts to which the bobbin is connected. In such a case as referred to above, it must be seen that the lead that the flyer has over the bobbin on the flyer lead frame is independent of the actual velocities of the flyer and bobbin, because the bobbin is made up of two speeds, and the flyer only one, both of which are of course rapidly rotating in the same direction. Now let us assume that the front roll delivers 10 inches; then the eye of the presser attached to the flyer must rotate the same number of inches farther than a point on the surface of the bobbin during the same time it takes the front roll to deliver 10 inches. In other words. when the flyer is leading the bobbin. the winding is accomplished by the velocity of the flyer presser being greater than the surface velocity of the bobbin. On the bobbin lead,

THE BOBBIN

rotates faster than the flyer, or leads the eye in the presser. Now let us assume the same here as we did with the flyer lead, that is, let us assume that the front roll delivers 10 inches; then in order to wind the inches delivered onto the bobbin in a bobbin lead frame, a point on the surface of the bobbin must move 10 inches farther than the eye of the presser attached to the flyer during the length of time that it takes for the front roll to deliver 10 inches of roving. It should be seen that this gain or lead of the bobbin over the flyer is also independent of the actual velocities of the flyer and bobbin, as the speeds of the bobbin lead frame are also made up of two parts or speeds.

In summing up the above, it should be seen that any lagging on the part of the bobbin, or the flyer starting in advance of the bobbin, will cause the roving to be stretched on the flyer lead frame. Another minor evil that was found in the flyer lead was that when an end did break, the end surely would escape from the threading slot of the hollow leg of the flyer. So it can be seen that the bobbin lead was a wonderful improvement, because from what we have said above, it can be seen that the bobbins take the roving from the eye in the presser; therefore, its circumference velocity must be the same as the presser, plus the velocity which makes up the two speeds. In such a case, it must be seen that in the bobbin lead frames, the flyer starting in advance (owing to its connecting gearing having less backlash) will cause a little slack, which is taken up when the full velocity of the bobbin has been attained. Thus it can be seen that the bobbin lead has eliminated one of the worst evils in the making of an even strand.

Now it is useless to say that if the bobbin did not increase

IN DIAMETER

as it filled with roving, the speeds of the flyer and bobbin could be easily regulated, so that the exact amount of roving delivered would be taken up and the tension would always remain the same. From what was said above, it must be seen that the conditions are more difficult than this, because one revolution of a full bobbin requires a much greater length of roving to make one turn around the bobbin than does one revolution of an empty bobbin; therefore, the circumferential speed of the bobbin must be the same, no matter what its diameter is. So it can be seen from the above that the surface speed of the front roll and the excess surface speed of the bobbin (or lead of the bobbin) over the flyer, should be equal. Such has been and is to-day the well-founded theory. In such a condition as referred to above, there is wound upon the bobbin just as much roving as is delivered by the front roll; therefore, a greater speed of the bobbin would produce a draft between the front roll and the bobbin, while a less speed would cause slackness of

the tension. All machine builders construct their machines on the above principle. No. 75.

LXXVI. BOBBIN SPEEDS.

If the surface speed of the front roll and the excess surface speed of the bobbin be equal, and the parts which give this excess speed, namely, the driven cone drum and its connections, are stopped, the speed of the bobbin will be exactly equal to the speed of the flyer. It should be clearly understood here that the speed of the bobbin is made up of two parts as stated; that is, a speed equal to the speed of the flyer, and another speed which is called the excess speed of the bobbin. From what has been said, it should be seen that when the bobbin increases in diameter, the excess speed of the bobbin must be decreased. It must be understood, also, that the actual speed of the bobbin is of course at the same time decreased, but it is only the decrease in the excess speed that affects the problem of winding, and it is only those parts connecting the cones and the bobbin gears, which govern the excess speed, that have their own speed changed. So any decrease in the speed of the driven cone has a proportionate effect upon the excess speed of the bobbin.

Then it should be quite obivious that as the diameter of the bobbin increases so must the

EXCESS SPEED

of the bobbin decrease. For if at one time 240 inches of roving be delivered when the circumference of the bobbin is four inches, the bobbin must make 240 divided by four or 60 revolutions more than the flyer in order that winding may take place; whereas, if the front roll delivery remains constant, as is always the case while the bobbin is being formed, and the circumference of the bobbin increases to 10 inches, the excess speed must decrease to 24 revolutions. It will thus be seen that the following proportion shows the relation between the excess speed of the bobbin and its circumference: 60 is to 24 as 10 is to 4, that is, the excess speed of the bobbin varies inversely as its diameter. Since the driven cone and its connections control the excess speed, its speed must vary inversely as the diameter of the bobbin. In order to provide for such a variation of the speed of the bottom cone, merely by moving a belt laterally along the cones and at the same time obtain the intermediate speeds, it is necessary that the cones be constructed, as was explained, with their well-known curved outline. From the bobbin driving gear of the differential motions, the speed of the bobbins may readily be calculated, and the absence or presence of draft detected. The wrong cone gear can also be discovered and the correct one found. The bottom cone gear is the gear changed to secure the correct intial bobbin speed. As the bottom cone drives the bobbins on all fly frames, too large a cone gear causes excessive tension, and one that is too small causes slackness of the tension.

When finding the size of the cone gear, a calculation for the speed of the bobbin may be made by using x in the place of the unknown cone gear. Then by substracting the speed of the flyer from this expression, another will be obtained representing the excess speed of the bobbin. Again by making this expression equal to the surface speed of

THE FRONT ROLL

divided by the circumference of the bobbin an equation will be formed, which may be solved for x.

Sometimes, owing to the slippage of the cone belt, the size thus found needs a slight correction, which can be obtained by moving the cone belt shipper to another point on the rack. The percentage of slippage is obtained by experiment only, and is caused mostly by carelessness, which has been explained in these articles, and also editorially. It was also explained elsewhere, that to facilitate the formation of a compact bobbin, some tension must exist at the proper place on the flyer. When tension is produced from this source, it

has by no means any detrimental effect upon the strand.

Now assuming that the proper tension has been obtained for the winding of the first layer of roving, we still have the problem of maintaining a constant uniform tension throughout the set.

This is a problem that is undoubtedly the most difficult of all those connected with a fly frame, because conditions vary, which influences this matter greatly, and the problem does not always lend itself to simple mathematical calculation, as a figured tension for a light running day would never answer on a heavy day; so that if the conditions at one time be known, aosolutely correct results for the time being only may be figured and secured in no other way.

The calculation referred to above, is required to find the rack or tension gear. From what has been said it should be seen that the maintenance of constant uniform tension depends upon a proper decrease in the excess speed of the bobbin, which, as was explained, is accomplished on all fiy frames by moving

THE CONE BELT,

which connects the two cones, a fixed lateral distance at the completion of the winding of each layer. If the distance be too great, the excess speed of the bobbin will decrease faster than the diameter of the bobbin increases, with the result that the tension will become slack. On the other hand, if the movement or distance is too small, the excess speed is not decreased sufficiently to avoid increased tension, and, consequent stretching of the roving, in some cases, breaking it. Much perplexity has been caused, and is caused today in our cotton mill card rooms by the occurrence of both of the above conditions, due to a lack of thorough knowledge of the working of the parts.

The American Wool and Cotton Reporter has in the past and is to-day constantly pointing out such defects with proper remedies. It will be found that an overseer, second hand or section hand is a great help to either poor or good speeder tenders when they have a thorough knowledge of the winding-on problem. No. 76.

LXXVII. THE SLUBBER-FRAME.

The carriage, which consists of the bolsters, skew gears, bobbin gears, and bolster rail completely enclosed which gives the necessary traverse to the bobbins, is given a vertical reciprocating motion, and is reversed at each end of the bobbins. This forms what we term the completion of the traverse. The carriage is supported by racks called slides, a portion of which moves in the grooved portion of the sampsons. As the carriage has considerable weight, owing to the weight of the bolster rail and such a large number of gears beside the casings the carriage is suitably balanced by weights hung at the end of each chain at each sampson. By referring to Figure 30 it can be seen by following the train of gears from the bottom cone, that the carriage and its gearing connecting the carriage to the bottom cone is driven by the bottom cone. Any resistance that is offered to the vertical reciprocating movement of the carriage, caused by a tight spindle, a broken chain supporting the weight, or neglecting to oil the slides acts correspondingly on the bottom cone, which causes the bottom cone to lag behind, owing to the friction on the cone belt and the result is a slack tension. Very few carders

CONSIDER THE ABOVE

causes of a slack tension. In some card rooms we find the bolsters so clogged up with dirt that on the building of the first layer when the carriage reaches its lowest level the frame will almost stop, owing to the resistance offered to the rotary axial motion of the spindles caused by the diameter of the spindles being larger at the bottom.

It can be seen if tight spindles will offer such a resistance to the driving belt, that it must give a still greater resistance to the cone belt, because the cone belt drives the carriage directly.

If a weight is allowed to remain off for many days, which happens often in our cotton mills owing to the carelessness of the second hand or fixer, resistance is caused, although not quite as great. Oiling the slides and chains is also important, neglecting this being the cause of a slack tention in many mills to-day, because when the slides are dry from the want of oil the carriage is not as steady in the reciprocating movement, and this causes the coils wound on the bobbin to ride one another, causing much breaking back in after processes.

In many such cases instead of oiling

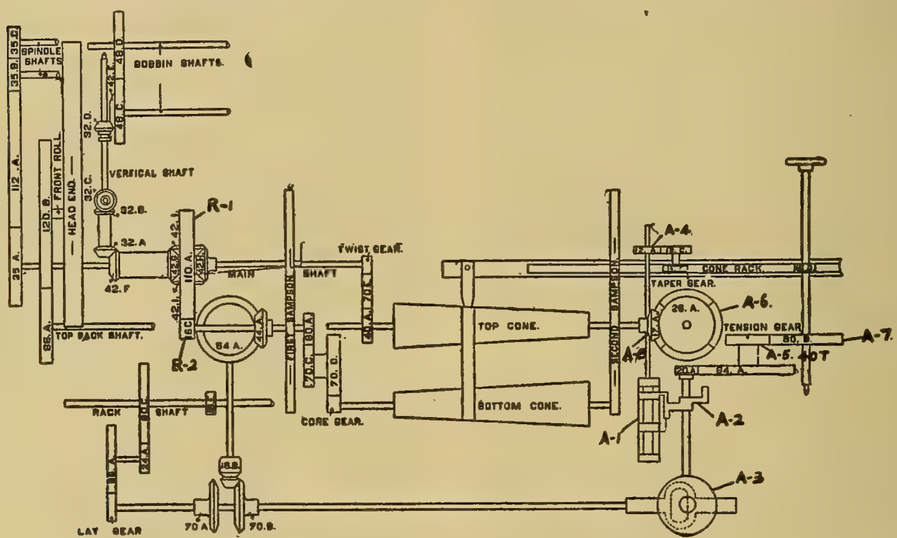


Fig. 30. Diagram of Gearing Showing Cones and Cone Belt.

the slides, twist is inserted in the roving with a consequent loss of production. We have had such cases come under our notice and the

TREASURER WAS BLAMED

for buying poor stock. When such conditions exist in any card room and the parts connecting the bottom cone and carriage are not understood, such a defect as referred to above is hard to locate, and, as stated, the man at the helm is generally blamed. It must be said here that this is only one case where many mill workers, by not giving the working parts due consideration, and are themselves to blame for existing conditions, blame the honorables, a term that is used by dissatisfied mill workers. One of the latest methods of overcoming the weight of the carriage is by means of a self-balanced carriage. The carriage is divided at the centre into two equal parts, and when one side is descending the other is ascending; therefore, one side balances the other. But what was said in describing the first type holds good here, because any resistance offered to either section acts correspondingly on the bottom cone, and a slack tension is caused on the self-balanced rail as on other types. Fly frames are designated by the length of the traverse described above which is the length of the first layer or coil wound on the bobbins, and the diameter of the full bobbin. Thus, a frame spoken of as a ten-inch by five-inch indicates that the greatest possible traverse on the bobbin is ten inches in length, and that when the bobbin is formed or filled, it cannot exceed five inches in diameter. Frames

ARE ALSO KNOWN

by the space, meaning the distance between the centre of one spindle to the

centre of the next spindle in the same row. For instance, the space allowed for a frame ten by five is eight inches. The reason for such a large space is to allow sufficient space for the clearance of the rod that is attached to the hollow leg of the flyers while revolving. It will be remembered that when we described the different types of flyers, it was said that in order to have the palm of the presser exert a slight continuous pressure on the surface of the bobbin, the rod with the presser finger must constantly have a tendency to fly outwards. So sufficient space, as decribed above, for clearance must be allowed. No. 77.

LXXVIII. NARROW GAUGE FRAMES.

Some mill men adopt narrow gauged frames in order to save floor space. This is very erroneous, because if the flyer mostly used in our cotton mills be examined, it will be found that the vertical rod attached to the hollow leg of the flyer has what may be termed a shoulder at its lower end. As all practical men know the presser is clamped to the hollow leg and sometimes owing to having been strained or worn this shoulder protrudes at a greater distance from the centre of the spindle, with the result that it is continally striking the next flyers. When the flyers strike one another the bolsters in a short time become loosened, which

INCREASES THE STRIKING

until the vertical rod is separated from the flyer and is caught in most cases by the revolving flyers with the result that many flyers are broken, and sometimes, the bolsters and skew gears are also broken. Fly frames are made of different lengths but are seldom made to exceed thirty-six feet. The reason for this is the torsion that would be caused on the rolls and shafts which would be excessive if they were constructed of greater length. Of course, it must be understood, for the reason given above, that a slubber frame could never be constructed to contain 200 spindles, which is the maximum number that the longest fly frame contains. Because it should be seen, owing to the space, that in order to have such a large number of spindles on a slubber the diameters of the shafts and roll would have to be increased to prevent torsion. Slubber frames having a gauge of ten inches twelve by six, should not exceed seventy-two spindles. It takes one-horse power to drive 36 spindles of the above dimension. Intermediate frames having a gauge of eight inches, ten by five, should not exceed 102 spindles. It takes one-horse power to drive 60 spindles of the above dimension. Fine frames having a gauge of five inches, seven by three and a half should not exceed 176 spindles. It takes one-horse power to drive 75 spindles of the above dimension. Jack frames having a gauge of four and a half inches, six by two and a half should not exceed 192 spindles. It takes one-horse power to drive 95 spindles of the above dimension. The second mechanism that acts in combination with the differential motion are

THE CONES,

that have for their object the reduction of speed of the controlling gear in the differential motion by which the suitable speeds for each layer added on the bobbin are obtained.

The two cones are connected together by a small belt, by which the upper cone drives the bottom cone. As was explained, this belt is gradually moved from the larger end of the top cone to the smaller end during the building of the bobbin. It must be understood here that a bobbin can be filled without the belt traveling the entire length of the cones, and that the belt can travel the entire length of the cones without filling the bobbins. This depends on the construction of the cones and the diameter of the strand and the manner in which the flyer is threaded and constructed. Not forgetting here that the length of roving wound on the bobbin always equals the excess speed of the bobbin over the flyer, and that

when the bobbin starts with a certain number of revolutions per minute, its rotary movement in excess of that of the flyer must be decreased in direct proportion to its increase in diameter, so it should be seen that when the diameter of the full bobbin is four times that of the empty one, the excess speed must be reduced to one-quarter. We have pointed out elsewhere that the cones should be considered as a continuous

LINE OF PULLEYS

connected together and that every layer added to the bobbin must be figured by itself.

The following examples are given to show how the intermediate speeds are obtained and secured in no other way than with the cone outlines. We do not figure every layer of the bobbins, but what we do give should be sufficient for the reader to get a clear understanding how the cones are constructed and how they are made to have such a peculiar formation. Let us assume that we are calculating two uniform cones without concavity and convexity.

Again we will assume that we wish to produce a six inch diameter full bobbin, the bobbin when empty having a diameter of one and a half inches, and the top cone is making 400 revolutions per minute, the length of the cones being thirty-six inches over all, with extreme diameter of six inches and three inches, the slipping of the cone belt or the thickness of the cone belt not being considered. We now take the increments of the bobbins by steps equal to one and a half inches from the empty to the full bobbin, thus: one and a half inches, three inches, four and a half inches, and six inches. We now divide the cones equally into corresponding portions; therefore, for the top cone we have six inches, five inches, four inches, three inches, and for the bottom cone three inches, four inches, five inches, and six inches.

From the above we will now calculate the speed of

THE UNIFORM CONES

and we have the following: 400x6 divided by 3 equals 800 revolutions of the bottom cone; 400x5 divided by 4 equals 500 revolutions of the bottom cone; 400x4 divided by 5 equals 320 revolutions of the bottom cone; 400x3 divided by 6 equals 200 revolutions of the bottom cone.

Now we will figure the speeds of the bottom cone, and as stated, we consider them as a string of pulleys, so we calculate the speed of the bottom cone at each division of the cones, and it can plainly be seen that it is not much of a problem after all to figure or construct cones, the calculations being the same as finding the speed of any ordinary pulley.

We now take the sizes of the bobbin at each division of the cones and we have the following:

Since 800 revolutions per minute of the bottom cone are required for one and a half inch diameter bobbins, the three-inch diameter of the bobbin will require the following revolutions from the bottom cone: 800x1.5 divided by 3 equals 400 revolutions, or speed of bottom cone; 800x1.5 divided by 4.5 equals 266.66 revolutions, or speed of bottom cone; 800x1.5 divided by 6 equals 200 revolutions, or speed of bottom cone.

From the above calculations it should be clearly realized that the diameters of the cones, requisite for giving the proper cone speed, if properly constructed, would prove to be concave and convex.

No. 78.

LXXIX. TREATMENT OF RACKS.

Now that the construction of the cones has been explained, we offer the following to show the harm that is introduced in almost all our carding rooms by allowing the speeder tenders to tighten, or let out the rack as it is termed. For the convenience of calculation we will assume that the diameter of the top cone is 5.25 inches, and the diameter of the bottom cone is also 5.25 inches. Again it is assumed that the top cone is making 400 revolutions per minute, and the speeder tender moves the rack when the frame is running too

slack, say, from 5.25 to 5.6 diameter on the top cone, and from 5.25 to 4.9 diameter on the bottom cone. We now have the following calculation showing how a slight movement of the rack destroys the relationship of the surface speed of the bobbin and front roll.

$\frac{5.25 \times 400}{5.25}$ 400 revolutions of the bottom cone before the rack was disturbed.

$\frac{5.6 \times 400}{4.9}$ 457 plus revolutions of the botton cone after moving the rack.

It should be seen from above that the moving of the rack should be branded as a crime. It is the cause for poor warping found in almost all cotton mills, caused by the strand being strained. This is caused by the surface speed of the bobbin being greater than the surface speed of the front roll. When the rack is moved back or forth, the tension gear itself, being one of the train of gears between the builder motion and the rack that carries the cone belt, is also moved back or forth, which acts correspondingly on the traverse of the bobbin. When a

RACK IS LET OUT

it will not cause the same evil as when the rack is tightened, as will be explained when the parts governing the up and down motion of the carriage are described. The distance traveled by the cone belt varies directly or inversely as the number of teeth in the rack or tension gear, depending upon whether the American or the English style of builder motion is used. In either case, the size of the gear required to make the cone belt move a desired distance may be obtained easily, but the distance that the belt should move is a hard problem to solve. One good method is to find the number of layers that can be put upon a bobbin by finding the thickness of the strand and the space occupied by each layer. The entire traverse of the belt divided by the number of layers gives the distance moved after each layer. The most difficult thing to do in such a problem is to determine accurately the diameter of the roving, which makes up the thickness of a single layer. Many rules are made for the number of layers that may be contained in an inch in terms of the size of the roving. While such rules are by no means absolutely correct, they give fairly good results. As stated, varying conditions, such as temperature, humidity and twist, influence the diameter of the strand, and, consequently, the diameter of the bobbin. No relation of diameter to number is

GENERAL ENOUGH

for universal practice, and actual experiments must be made under different conditions.

The American Wool and Cotton Reporter has often pointed out that temperature and humidity can be controlled nowadays with considerable ease and accuracy with the self-regulating humidifiers. But we are forced to admit that even when humidifiers are used, some variations are inevitable—caused mostly by the use of cotton grown in different climates. But eternal vigilance can assist greatly in keeping that relation which theory and practice have shown to be the best.

As stated, when calculating the contact or tension gear, the style of builder must be taken into consideration. It should be remembered that the English style of builder motion differs from the American style. That is, the larger the contact gear used on the English style of builders, the more tension on the ends, owing to the movement of the rack being very small. This is due to the fact that the rack gear in the English style is always of the same diameter, the size of the teeth in the gear being changed, while on the American style, the diameter of the gear is changed and not the size of the teeth in the gear.

The larger

THE RACK GEAR

in the American style, the less tension on the ends, because the tension gear drives the rack directly. Then the larger the gear the greater the distance the rack travels at each completion of the traverse. On the English style, the larger the number of teeth in the rack gear the smaller the teeth in order to have the same circumference of circle;

as the rack is let out a distance equal to one-half a tooth of the rack gear, it should be seen that the distance traveled by the cone belt is smaller when a large rack gear is used.

When changing from one hank roving to another, the following rule, which is the same as given for finding the twist gear elsewhere, will be found accurate. To find the rack gear:

Rule.—Multiply the hank roving now being made by the rack gear now on, divide by the hank roving desired, add rack gear to quotient and divide by 2.

Example.—Suppose we are making 4 hank roving with a 15-tooth rack gear, what rack gear will a 5-hank roving require? 15x4 equals 60 divided by 5 equals 12 plus 15 equals 27, divided by 2 equals 13.5 rack gear; then try a 13-rack gear and if too slack put on a 14. If a 14-rack gear is put on in the first place, when the tension becomes too tight, much damage is done to the roving before it is discovered.

No. 79.

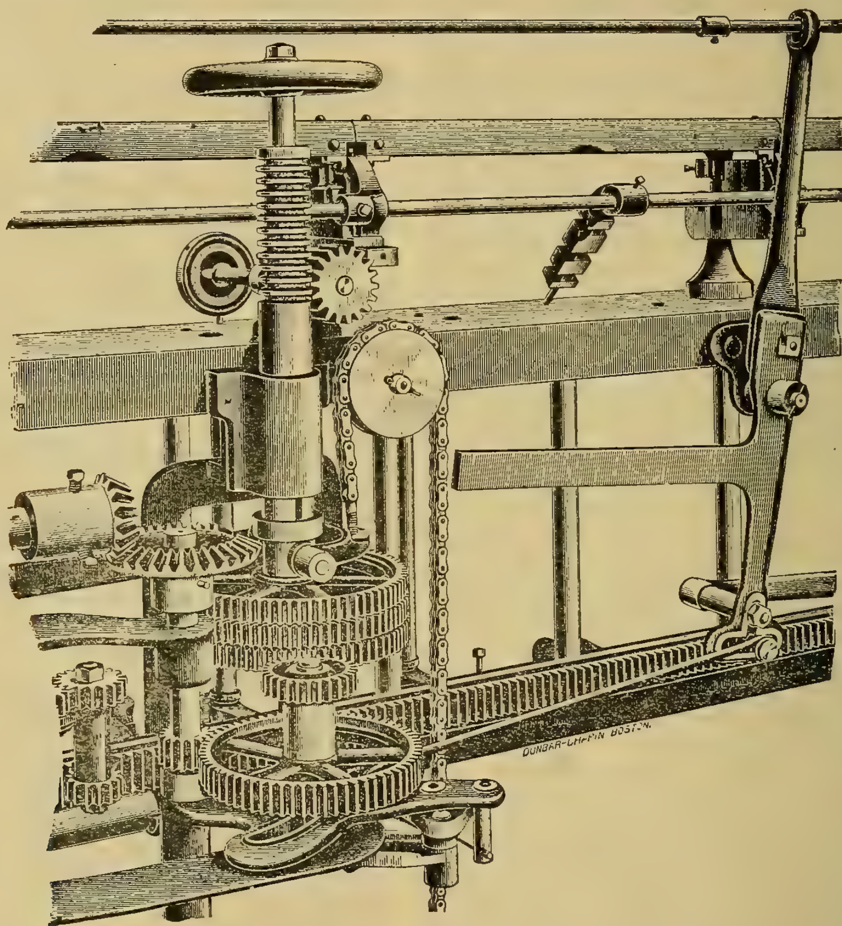


Fig. 31. An Arrangement For Obtaining Proper Tension.

LXXX. CONDITIONS AFFECTING WARPING.

As was stated, even if the proper tension, so called, has been obtained for the winding, we still have the problem of maintaining a constant tension throughout the set. In some

cases, this cannot be accomplished by the tension gear alone. Figure 31 shows an arrangement that will give just the proper tension no matter how slight the atmospheric changes are. By referring to Figure 30, the difference between the tension gear and one of the three gears on the rack shaft shown in Figure 31, can plainly be seen. The change of the tension gear is about one-fortieth, more or less, while in changing from one of the three gears to the other, the change is from one-eighthieth on coarse frames to one-ninety-fifth on jack frames. It should be seen from the above that such a device is valuable, especially in New England, where atmospheric conditions change so often, even in a day. If the reader will go back to the example we have given, showing the evil that is caused by moving the rack, or by not having the proper tension gear that will cause a tight tension, it will be seen that such a device will go a long way in preventing the strand from being stretched which makes the work lighter and weaker.

If the carder had charge of the warping, there would be much less strained roving in a cotton mill. It only takes a visit to any warping room to be convinced whether the speeder tenders in that mill are tampering with their rack or not. The arrangement shown in Figure 31 is to overcome, as far as practicable, all of the above conditions. With such a device, the speeder tender cannot

MOVE THE RACK,

and the only way the rack is moved is by removing the tension gear. Of course, we must admit that even with this device, speeder tenders do tamper with the racks, but the overseer is to blame for such conditions. The rack gears in most card rooms would be changed oftener if it was not so much trouble, and all practical men will agree with the writer that if the second hand or fixer refuses to change the rack gear, the tender does not dare tell the overseer, because it is well known that such a move on the part of the tender may mean the loss of his position. We also find this device much neglected, simply because the overseer or fixer in charge does not understand the winding-on problem. The above device is valuable, because no gears or wrenches are needed to make the change quickly, which is accomplished from the front of the frame, by unlocking a controlling wheel and turning the handle to the right or left. When making such a change, it can be done without having to crawl down under the frame, so by making the changing of gears more simple, the matter receives more attention, which means better work throughout the mill. Of late, we notice that very little attention is given to this useful device in most card rooms. The writer has heard even the men that set up machinery, of which this device is a part, admit that such a device is useless.

No. 80.

LXXXI. AMERICAN BUILDER MOTION.

From what was said and from the examples given, it should clearly be seen that a still finer change would be appreciated, and every fly frame should consist of such a device. By again referring to Figure 30 (in our December 15 issue), the American type of builder is plainly shown at A1, A2, A3 and A4. It can be seen at A1, that the dog A2, having two arms, is prevented from turning by coming in contact with one of the jaws of the builder. It should be understood that A1 is raised and lowered by the carriage, and that the small rod that connects A1 and A4 is squaré shaped, as is also the hole for its reception in A4, which is indirectly turned at each completion of the traverse by the train of gears, connecting the gear on the tumbler shaft, which carries the dog to A4. When this square rod is made to revolve a part of a revolution, the two jaws at A1 are brought closer together, owing to the part of the square rod having

right and left hand threads. The

TUMBLER SHAFT

which carries the dog A2, has a disk A3 at its foot, which carries two lugs. A casting to which a spring is attached is made to press on one of the lugs which tends to give the shaft a partial revolution, but is prevented from so doing as stated. When the carriage is moved up or down sufficiently so that either jaw will clear the arm of the dog in contact with said jaw, the spring is allowed to act on the shaft and turn it until the gear A8 on the end of the top cone engages the teeth in one of the sections of the gear A6. By the engagement of these two gears, the shaft is given a one-half revolution and at the same time the blank section of A6 is presented to A8, at which point the spring will act on the other lug in the disk at the foot of the shaft. It can be seen that when the tumbler shaft makes one-half revolution, the gear 70A is brought in contact with gear 16B and the traverse is reversed. The shaft by making a one-half revolution will move the cone belt a lateral distance along the cones. Again, it must be understood that one-half turn of the shaft gives a part revolution to A4, that causes the two jaws to come together, which makes the traverse shorter at every completion of the traverse. So from the above, it should be seen that when a speeder tender is allowed to move the rack besides destroying the relationship of the

SURFACE SPEED

of the front roll, and the surface speed of the bobbin, the shape of the bobbin is also given a poor appearance. We have explained elsewhere that when a speeder is tightened, it causes more evil than when it is let out. It should now be easily seen by the reader, from what we have said, that no harm is caused to the roving when the rack is let out, because the tension is made slacker and the traverse is made shorter. On the other hand, if the frame is tightened, the roving in most cases is strained and the traverse is lengthened. Now each layer is made shorter at each completion of the traverse to the same extent as the diameter of the strand, and it has been pointed out that at the completion of each traverse A4 is given a part revolution and the two jaws at A1 are spread apart.

In such a case, the carriage will travel a greater distance, which makes the traverse longer, and consequently, the coils are wound around the tapered part of the bobbin. Running over and under, as it is termed, is the cause of much trouble in our cotton mills to-day, it has even caused strikes in the past. Mule spinners, as a rule, detest a bad built bobbin, because the coils wound on the tapered part of the bobbins, will wind around the skewer, and it makes it necessary for the spinner to go around at the back of the

MULE CREEL,

a practice which they do not like.

If the speeder tender moves the rack too great a distance, the frame is made to have a discouraging appearance, because the diameter of the bobbin is so small at the tapered part that the surface speed of the bobbin is not great enough at this point to take up the amount of roving delivered from the front roll; consequently, the largest number of ends will escape the threading slot in the hollow leg of the flyer, while others will wind around one another.

When the rack is moved so as to affect the traverse slightly, a few coils protrude from the top or bottom of the bobbin and are caught by the spindle or bobbin gear.

When the roving is wound around the spindle, it will in most cases, if not detected in time, cause fire. It must be said here that the American type of builders are best if let alone, because if the tension of the spring is set to give the right pressure on the lugs a bobbin with a taper of 30 degrees can easily be constructed without any coils running over and under. But what we said about the cam parts on combers can well be applied here, that is, that the tension of any spring or setting of cams properly cannot be obtained from

books, but instead, it requires practice and diligent study. For just such a reason, it is impossible to have in book form the proper traveler that should be used for a certain tension on a ring frame. No. 81.

LXXXII. ENGLISH BUILDER MOTION.

Figure 32 and 32A show a style of builder called the English type. The bracket A, which is called the

POKER BAR SLIDE,

is attached to the carriage and as in the American type, A is taken up and down, or in other words, it follows the movements of the carriage. The rod A3, that connects the bracket A to the rocker K, is known as the poker bar. The poker bar being attached to bracket A follows the carriage, also gives a rocking motion to K. A1-A1 are the slides for the reception of a washer that fits the stud A2, and also the slides A1 on each side of bracket A. An arm B is also attached to the bracket A, and carries the weight cradle E. E is centred at E1 and serves as a cradle for the operation of cradle F, and weights G, G1. From what has just been said, it should be seen that as the carriage travels up and down it will carry with it bracket A, and the poker bar which as stated gives a rocking motion to rocker K, and the cradle E is also given a rocking motion. The vertical shaft H carries two gears B2, H1. The gear B2 meshes with the teeth of the rack B3 that moves the cone belt along the cones, while the gear H1 meshes with gear H2; H1 and H2 are bevel gears, H1 being fastened to the end of the vertical, while H2 is fastened to shaft S. Fastened to the shaft S are the gears W and W1, the gear W1 meshing with the teeth cut on the under side of the poker bar A3. The gear W is the

RACK GEAR

and is operated by the two pawls W2 and W3. The drum H3, at the top of shaft H on which a chain Z is wound, receives a constant tendency to unwind, due to the pull that the weight Y exerts on drum H3, and the chain would be entirely unwound from the drum were it not for the engagement of the stop pawls with the teeth of the rack gear. Cradle K is loose on shaft S, and carries a bracket with two wings, X1 and X2, which take the pawls out of contact with the rack gear, one pawl being out of contact for one traverse, while the other pawl is out of contact, the next traverse. At the upper part of cradle K, there are three projections, F1, F2 and F3. F1 forms a shoulder for each latch C and C1. C and C1 are kept in contact with cradle K by means of a spring F4, that passes under the shaft S, and is connected to latches by two setscrews or studs, F5 and F6. Thus, it can be seen that there exists always a constant pressure on the latches C and C1, in a downward direction. The latches C and C1 are centred at C2 and C3, and are rocked by the screws in the top part of rocker K. The rods V and V1 have the weights G and G1 attached to their lower ends, while the upper part passes through each side of cradle F. The weights are raised and lowered at point E2 and E3. It can be seen by the position of the latch C that the weight G will be supported by the projection F2 when the rail is making its

UPPER MOVEMENT,

and E2 is depressed from under V2. It is our intention to show that this type of builder will give more trouble than the American type, so in order to prove what we say is true, the operation of each type will be explained.

Let us assume with the English type of builder, that the rail or carriage is making its upper movement, then we have the following operation of the builder.

The carriage on the upper movement carrying up the end of the poker bar, thus raising the side of cradle E, attached to B and lowering the cradle at E2, causes the weight G to rest entirely on F2; this would, of course, give a rocking ac-

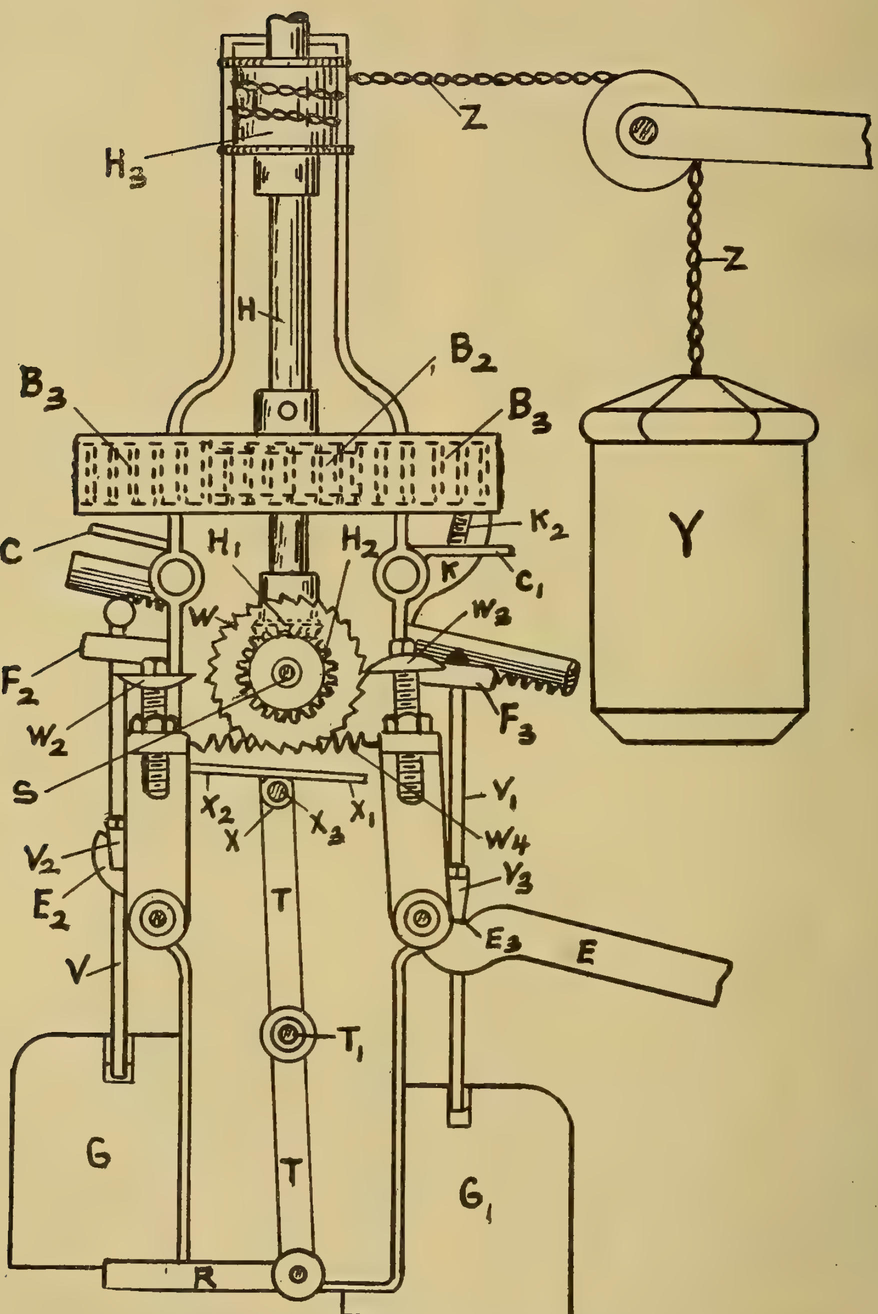


Fig. 32. English Type of Builder.

tion to rocker F if the latch C was not in contact with shoulder F1. As stated, when the rail has raised so that the screw K1 forces the latch C out of contact with the shoulder F1, the cradle is pulled over by the dead weight of G. It can be seen that the raising of E3 allows the weight G to rest on F2, and at the same time raises V1 to a point high enough not to give any resistance to the rocking of F, attached to the weight G1 from the projection F3. By raising point E3 the weight is borne by the cradle at this point instead of resting on F3. By following the movements of rocker F, its movement, due to

BEING CENTERED

at S, will transmit a like movement to the bracket X in the opposite direction. As was stated the bracket X forces the pawl W3 out of contact with the rack gear, and this allows the vertical shaft to rotate a slight part of a revolution, until the pawl W2 is brought into contact with the rack gear which has made a part revolution equal to one-half tooth of the gear.

The movement of the vertical shaft by means of gear B2 moves the rack a small lateral distance along the cones. It also gives a part revolution to gear W1 that meshes with the under side of the poker bar, thus bringing the end of the poker bar nearer to the cradle K. As the poker bar has been shortened by this movement, it should be seen that on the next traverse the setscrew K2 will force down the latch C1, when the carriage has moved a shorter distance than on the previous traverse. This can be more readily understood by considering the poker bar to be say, 20 feet in length, and made to move the length of a 10-inch traverse. Thus, the movement of the rocker would be slight. On the other hand, if the poker bar was only 12 inches long and moved 10 inches, it can plainly be seen that the movement of the rocker would be faster greater No. 82.

LXXXIII. ADVANTAGE OF AMERICAN BUILDER.

So, from the above, it is plain that the shorter the poker bar, the more the traverse is shortened, which, of course, gives the bobbin more taper. As was stated, the American type of builders are best for the

SIMPLE REASON

that the only thing which will prevent the tumbler shaft from turning is not having enough tension on the spring or by the spring breaking. While, on the other hand, if a bobbin or any piece of matter should, by accident, be pushed under either weight of the English type, the downward pull necessary to pull over the rocker F is destroyed, and the movement of the carriage is allowed to continue in its direction, and if the frame is not equipped with a stop motion, the rack studs and gears, in most cases, are broken, beside breaking down the ends. Another evil that is caused by the use of this builder is which improves the looks of the bobbins when the builders are worn. that the end of the latches becomes rounded, as does also the shoulder of the rocker F. When the latches and shoulder are in such a condition, much running over and under of the coils is caused at each end of the bobbins. The reason for this is that the rocker being rounded and having a tendency to press against the end of the latch, will, owing to the pull exerted by the weight G or G1, sometimes force the latch out of contact before the carriage has completed its traverse. Sometimes this is done at every traverse of the bobbin for many layers, when, owing to some rough substance, or from other causes, the rocker is not free to rock until either screw K1 or K2 has depressed the latch, and running over or under is caused. The writer has found it very beneficial to rub the ends of the latches with emery cloth from time to time, which improves the looks of the bob-

bins when the builders are worn. However, the best method is to take out

THE ROCKER

and latches and square them to one another so as to make the change sensitive. Another defect is that the momentum of the weights continually breaks the hooks of the rods V and V1. Again, if any foreign matter lodges in the teeth of any gears to jump many teeth on the rack, which lengthens the poker bar, and running over or under is caused on the first layer. Sometimes the frame is doffed with the carriage very low or high, which gives more room for stud A2 at the end of the poker bar to be forced farther to the end of the slide, the gear B2 jumps the teeth of the rack, with the result that when the rail is lowering the poker bar,

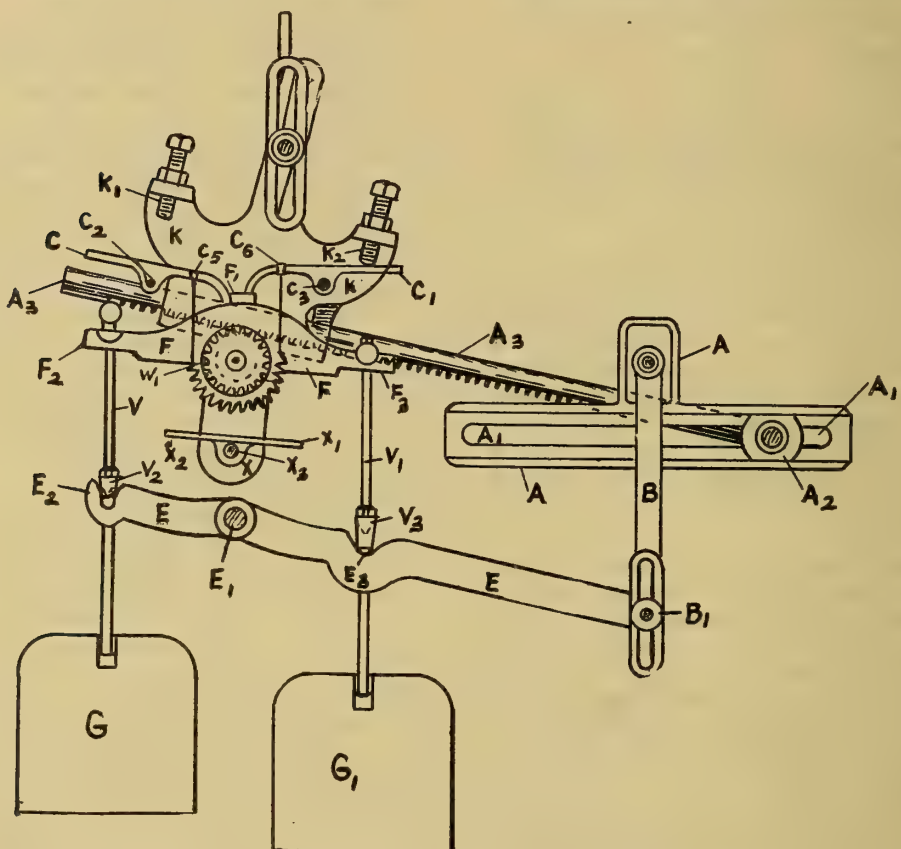


Fig. 32A. English Type of Builder.

operating the rack, or in the teeth of the rack or pocket bar, the resistance becomes too great for the weight Y to rotate the vertical shaft, and, consequently, the rack remains in one position, which causes the ends to be strained and the coils to run over and under. Another defect is that many speeder tenders will often wind the rack too fast, which causes gear B2 it does not have the necessary sweep, and, consequently, breaks the slide from the carriage. When the shoulders or latches are worn, the sweep of rod R is reduced, which necessitates the twin gears shown in Figure 30 to be set closer, and in some cases, when the shoulders and latches are worn badly, a new rocker or new latches are re-

quired to give space enough to the twin gear pinion so as to cause no friction when acted on by the rod R. Again, when it is necessary to raise

THE TWIN GEARS

are set too close, one twin gear must

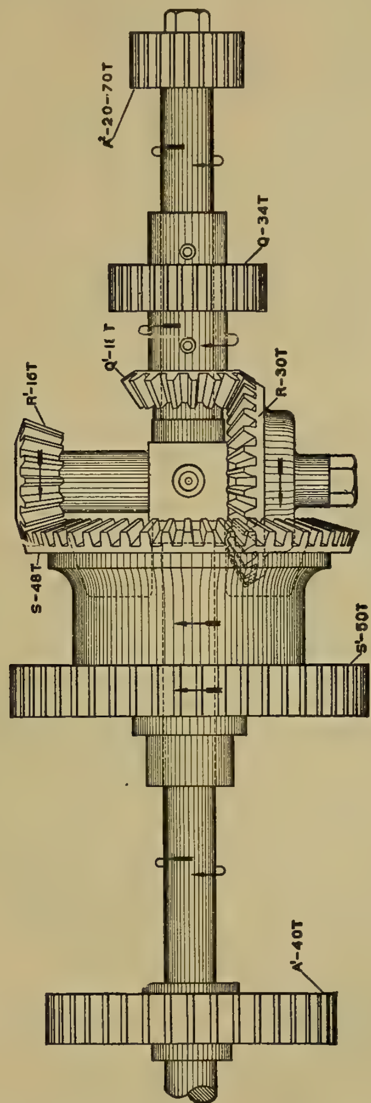


Fig. 33. Differential Motion.

be loosened and more space given. In a case such as described above, when a new rocker or latch are not available, a good practice which is resorted to in many mills is to saw a slot on the side of one shoulder and insert a small piece of steel, properly riveted and shaped, like the projection that forms the shoulders, thus increasing the space between the twin gears. By again referring to Figure 32 and 32A it can be seen that the stop pawl W2 occupies a position on the half-tooth of one of the teeth in the rack gear. When a rack gear is changed to an odd number, that is, one, three or more teeth, the stop pawl must be set so

that it will occupy a position shown in the figure, because from what has been said, it should be seen that at every completion of the traverse, the rack gear is let out one half-tooth. As every layer should be of the same diameter as other layers, it is obvious that the distance or movement of the rack gear must be equal at each completion of the traverse. So this setting is important, and one, we regret to say, much neglected. From the example given elsewhere, in regard to moving the rack, it should be seen that if the rack gear is not let out equally by each stop pawl, the tension will be too tight on the traverse when the movement of the rack gear is too small, and too slack when the movement is too great, thus making the work

RUN BADLY.

When a rack gear is changed, it will pay any fixer or person doing the changing to make a mark on the top side of the rack and mark each change of the traverse, to see if each movement of the rack is equal. If it is found that W2 is letting out the rack gear more than W3, W2 must be raised until the distance is equalled. When a new frame is started, or when it is necessary to set the poker bar, the first thing to do is to run the carriage either by hand or power until it occupies a central position between the shoulders of the bobbin, and then a mark should be made on the bobbin exactly at the eye in the pad of the presser. The presser must, of course, be in a proper position and not raised or lowered below the end of the hollow leg of the flyer. A level should then be placed on the poker bar and the bracket A set so that the poker bar is leveled, then the bracket A should be tightened. The frame should then be started, and the length of the traverse regulated by the screws K1 and K2. No. 83.

LXXXIV. DIFFERENTIAL MOTION.

As stated, the bobbin is made up of two speeds, which is accomplished by the first mechanism known as the differential motion. This motion, of which there are various types, all have the same object; that is, to provide a ready means of

AUTOMATICALLY REDUCING

the number of revolutions per minute of the bobbin in exact proportion to the increase in its diameter. The Houldsworth compound is shown in Figure 30, while one of the latest types is shown in Figure 33. The chief feature attending the introduction of all new differential motions has been the speeding up of the gear Q on the differential sleeve, which has taken the place of the large sun wheel of the Houldsworth motion. It must be understood by the reader that the high speed of this gear is not obtained by a higher speed bottom cone, but by the use of a train of gears between the bottom cone and the gear on the differential sleeve. Now, which is the best speed-reducing value, the new differential motion or the Houldsworth differential motion? The sun gear, as a rule, may contain from 100 to 120 teeth with the differential motion shown in Figure 30, whereas its more recent substitute contains from 30 to 36 teeth. It should be seen that this difference alone, representing a speed of the gear on the differential sleeve in the new motions, is equal to about four times the speed of the sun gear of the Houldsworth motion. The contrast between the two motions should be noted here. The lowest axial revolutions of the train of gears in the periphery is attained with the highest speed of the differential sleeve, while the contrary is often true in regard to Houldsworth's motion.

The chief

CLAIM MADE

for all new differential motions is that by having all parts rotating in the same direction as the driving shaft, the friction is greatly reduced, some builders going so far as to claim that the bottom cone is no longer a driver.

From what we have said regarding the high speed differential sleeve in the new differential motions causing a low axial speed to the gears inside

the periphery, we will prove here that the gear Q1 on the end of the differential sleeve meshing with the gear R on the end of the cross shaft works against and checks the axial speed of the gear R inside the periphery. This is obtained by the gear R inside the periphery rolling around the gear Q1 on the end of the differential sleeve.

To prove the above, let us assume that the bottom cone is lifted, which slackens the cone belt and stops the bottom cone, which, in turn, stops the differential sleeve, but the gears inside the periphery will then have their highest rate of axial revolution, because there is no check imposed upon such revolutions. In the motion shown in Figure 33, the bobbins obtain four-fifths of their total revolutions from the rotating small cross-shaft and the other one-fifth from the differential sleeve driven by the cones so that when

THE LOWER CONE

is raised and the belt is slackened, which stops the bottom cone, so also is the one-fifth part of the bobbin revolution taken away for the time being. Now let us assume that the cone is again lowered and the differential sleeve is rotated in the same direction of the driving shaft and periphery. It should be seen that the axial speed of the gears inside the periphery is decreased to the number of revolutions that are made by the differential sleeve. From the above it should be clear to the reader that if the differential sleeve was in any way disconnected, it would rotate in the opposite direction to that of the driving shaft, because in such a case the periphery would be stopped and the small gear R1 on the cross-shaft would roll around the large bevel gear S of the periphery, thus rotating the cross-shaft in the opposite direction and in this way the differential sleeve would be made to revolve in the opposite direction to that of the driving shaft if disconnected from the train of gears. It should be seen that the power to drive the bobbins is taken from the differential sleeve and that the cones drive the bobbins, because we think we have proven that when the cone is stopped the gears inside the periphery obtain the power from the

DIFFERENTIAL SLEEVE,

and that if there is a disconnection between the bottom cone and differential sleeve the bobbins will stop, which proves that the cone does drive the bobbins on differential motions, old or new. This is the cause of much trouble in some mills where this defect is not understood; that is, that the high speed of the bottom cone or the train of gears used to obtain the high speed of the differential sleeve makes the start of the bottom cone much harder than on the old or Houldsworth's motion. This can be noticed more at the beginning of the set when the cone belt is on the small end of the bottom cone, because the top cone drives the bottom cone, and as the belt at the beginning of each set is on the largest diameter of the top cone and on the small end of the bottom cone, the ratio is greater at this point and consequently causes more slipping. If the driving belt is shifted onto the tight pulley too suddenly the ends will all slacken, and in most cases, many ends are broken by winding around one another. No. 84.

LXXXV. THE CONE BELT.

In order to overcome this slippage of the cone belt, the belt must be tight at all times, which of course, weakens the cone belt and more belt breaking is caused with the new differential motion than with the old motion. All frames equipped with a new differential motion must be started slowly throughout the set, a point that is much misunderstood by most mill men, because they

CANNOT SEE

how it is possible for the cone belt to slip when the set is nearly filled. It is pointed out that the cone belt at this point is on the small end of the top cone and on the large end of the bottom cone, which of course, gives the top cone a better chance to drive the bottom cone. Al-

though the above is true they seem to forget that there is an enormous amount of weight on all bobbins at the finishing of the set. For instance, on a slubber of 72 spindles, the bobbins at the end of the set each weigh about $2\frac{1}{2}$ pounds; so $2\frac{1}{2}$x72 equals 180 pounds more on all bobbins than at the beginning of the set that the cone belt is called on to drive, which, of course, makes the consumption of power greater on the cone belt at the finishing of the set. The above is also true with the Houldsworth's motion, but the belt is not so liable to slip when the frame is started, because the train of gears or the pinion driving the sun gear is of a much lower speed than its substitute, as was explained. To overcome this cone belt breaking, some makes of speeders having the new differential motion have an auxiliary belt to prevent the ends from breaking. So it can be seen from the above that what we thought was an improvement introduced disadvantages. Many inventors are working to overcome the cone belt breakage and the result has been an auxiliary belt. Although this auxiliary belt is used to

SOME ADVANTAGE

in some mills, it is as a rule much neglected in others for the simple reason that when the cone belt breaks, and is pieced again the auxiliary belt must also be shortened, because if the bottom cone occupies a position which makes its drop too great, it will stop suddenly owing to the resistance power this cone is called upon to transmit. When the bottom cone is engaged with the auxiliary belt and not up to its regular speed, the ends are not saved, because the auxiliary belt is much lighter than the cone belt, and it is unable to increase the speed of the bottom cone to the same rate of speed it was at when the cone belt broke, consequently the ends are broken.

By referring to Figure 30, (in our December 15 issue) which shows the Houldsworth differential motion, the gear H on the driving shaft drives the bobbins, its motion being imparted through the gear I-I to the gear G, which is on the differential sleeve with gear F. The gear F drives the bobbins through the gears A, B, C, D and E. The speed of the gear H is constant, but by the arrangement of gears G, I-I and R1, it is possible to alter the speed of the gear G independently of H, thus altering the speed of F, and consequently that of the bobbins. The alteration in the speed of gear G is obtained by imparting motion to the gear R1, by the bottom cone. When the first layer of roving is being wound on the bobbins, the cone belt is at the large end of the top cone, and at the small end of the bottom cone, as on the new differential motion already described, but as the bobbins

GRADUALLY GROW LARGER,

the belt is moved along the cones, until at the finish of a set, the cone belt is at the small end of the top cone and at the large end of the bottom cone. So as with the new differential motion, the top cone being a driver, any parts receiving motion from the bottom cone will have their highest speed at the beginning of the set, and their lowest speed at the finish.

By again referring to Figure 30, it can be seen that a gear on the end of the bottom cone drives through suitable gearing, the gear R2, called the compound pinion, which meshes with the sun gear R1; consequently, as the cone belt is moved from the small to the large end of the bottom cone, the speed of gear R2 and the sun gear R1 will be lessened. The sun gear supports by means of studs, the two bevel gears I-I on which the gears work loosely. When the sun gear R1 revolves, it carries with it the two bevel gears, I-I, which at the same time, as stated, are free to rotate on the studs.

The gear H being fastened to the driving shaft, drives the gear G through the carrier gears I-I. The gears I-I perform the same work and one may be imagined as not existing for the present consideration, being used merely to balance one another, and cause the whole arrangement to revolve more uniformly. The gears

H and G each contain 42 teeth, and consequently if the sun gear R1 were held still, H would drive G at the same speed, but in the opposite direction. If, however, the sun gear R1 is made to revolve in the same direction as G, the latter makes not only the number of revolutions that it drives through, being driven by H, but an additional

NUMBER OF REVOLUTIONS,

caused by the sun gear R1. In order to fully understand the above, consider H as standing still. If we turn the sun gear through one revolution in an opposite direction from the driving shaft, G will also make one revolution. Now it is obvious that if one revolution of H will impart one revolution to G, and one revolution of R1 will impart one revolution to G, G will make two revolutions. But it must be understood that the sun gear R1 must make one revolution around gear H while H is making its one revolution, and in order to do this, it should be seen that the sun gear R1 must make two revolutions, that is, one revolution when the gear H is considered standing, and one revolution while it is revolving, which makes up the two speeds as described in the new differential motion. The above may be more fully understood by taking the following actual example. Suppose that the driving shaft makes 300 revolutions per minute. If the sun gear R1 is held still, G will make 300 revolutions also, but, as stated, in the opposite direction. Supposing that the sun gear R1 is now caused to revolve 10 times per minute in the same direction as G, we have the following: 300 plus (10x2) equals 320 revolutions per minute of G. By again referring to Figure 30, it can be seen that the driving shaft revolves inside the differential sleeve and in the opposite direction, wich was the chief defect found against the Houldsworth motion, because the friction at this point was very great. The speed in some cases is as high as 1,000 revolutions per minute. The means employed to reduce this friction were outlined in the American Wool and Cotton Reporter of December 8.

It must be understood that in giving the above speed, we mean that

THE DRIVING SHAFT

is making 500 revolutions in one direction and the sleeve making 500 revolutions in the opposite direction.

Few will admit that the new differential motion causes more cone slipping and cone belt breakage than the Houldsworth motion. The writer has, nevertheless, found this to be a fact. No. 85.

LXXXVI. ROVING WINDING.

In order to prove that it is impossible for the winding-on of the roving to take place when the bottom cone is stopped, and also prove that the bottom cone is a driver, we offer the following examples. We will first consider the Houldsworth motion shown in Figure 30, and for the convenience of calculation, we will assume that a gear on the spindle shaft with 40 teeth drives through a large intermediate 40-tooth gear on the spindle shaft, and that a 55-tooth gear on the spindle shaft drives a 22-tooth gear on the spindles. The revolutions of the driving shaft per minute will be considered as 400. This gives 400x 40x55 divided by 40x22 equals 1,000 revolutions of the spindles per minute.

We will now find the speed of the bobbin. It is assumed that the bottom cone is raised, which causes the sun gear to stop.

Again for the convenience of calculation, let us assume that the gear on the differential sleeve has 40 teeth and drives through an intermediate 40-tooth gear on the bobbin shaft, and a 55-tooth gear on the bobbin shaft drives a 22-tooth bobbin gear.

Thus, we have the same calculation as above, because it was pointed out elsewhere that when the sun gear was stopped, the differential sleeve made the same number of revolutions as the driving shaft, because the bevel gear H meshing with the two stud gears I-I contains 42 teeth and the

gear G, 42 teeth. So it can be seen that the bobbins, like the spindle, make

1,000 REVOLUTIONS

per minute. It is impossible for any winding-on to take place, and the bottom cone ceases to be a factor in driving the bobbin. So it must be admitted that the bottom cone must be lowered in order to set the bobbins in motion, which proves that the bottom cone drives the bobbins.

The above is a fact that has been understood by most mill men, and never disputed, but it is merely given here simply to give a better understanding of the two motions. We next consider the new differential motion with the cone belt raised, which stop the differential gear Q.

Again for the convenience of calculation, we will assume that a gear with 40 teeth is on the spindle shaft, and, as on the old motion, transmits through a large intermediate, another gear with 40 teeth on the spindle shaft. The latter drives a 55-tooth gear which drives the spindle gear which has 22 teeth. This gives the same example as in the first case, and we have 1,000 revolutions for the spindles. Now let us assume that the gear Q1, Figure 33, (in our issue of December 22), contains 18 teeth, the gear R, 30 teeth, and the gear R1 16 teeth, and the gear S 48 teeth, as shown in the figure. The gear S1 drives the bobbins and contains 50 teeth. In order to fully understand this motion, the rolling of R around Q1 should be figured in the same manner as figuring any other speed; that is, consider that when the driving shaft makes one revolution, the short cross-shaft is taken around with it, and the cross-shaft at the same time takes the gear R around Q1, and as Q1 has only 18 teeth and R 30, it should be seen that

THE CROSS-SHAFT

will not make a complete revolution. If R contained 18 teeth as the gear Q1, the short shaft would just make one revolution, but, as stated, the gear R contains 30 teeth, so we have the following: 18 divided by 30 equals .6 of a revolution of the cross-shaft when the driving shaft has made one complete revolution. Gear R1 contains 16 teeth so we have 16x.6 divided by 48 equals .2, or one-fifth. So it can been seen that if one-fifth is lost when the gear Q is stopped, the gear S1 will make one-fifth revolution less than the driving shaft at every revolution of the latter. As was stated, the gear S1 contains 50 teeth, so it should be seen from the above that if it loses one-fifth at every revolution of the driving shaft, the gear S1 counts as 40, and we have the same calculation as when finding the speed of the spindle, and the spindle and bobbin gears make the same number of revolutions. Or take away one fifth revolution from the differential sleeve and we have 320x50x55 divided by 40x 22 equals 1,000, revolution of bobbins.

It should be seen that when a loss of one-fifth is considered, the gear S1 must be figured by the number of teeth it contains. Thus, the cone belt must also be lowered in order to receive any motion from the differential sleeve, which proves from what has been said elsewhere about Q1 checking the speed of R, that the bottom cone drives the bobbins as on

THE OLD MOTION.

Another proof that can be made easily, and that will conceive the most skeptical on this point, is to remove the sun gear pinion that meshes with the sun gear, and it will be found that the sun gear will remain in the same position. Now remove the carrier gear on any new differential motion meshing with gear Q, and it will be found that the differential sleeve will revolve at a high rate of speed in the opposite direction to that of the driving shaft, and if held by the hand, it will be found that it offers much resistance. Such a test should be enough to convince the most skeptical that the old motion having a sleeve separating the driving shaft from the differential sleeve offers less resistance to the cone belt, which enables a speeder equipped with the old motion to be started more quickly. Again, it should be seen that on the old motion where very little resistance is given to the cone belt, we find a sun

gear pinion of about 25 teeth driving a gear of 120 teeth. While on the new motions, we find in most cases a much larger gear driving the gear Q, in some cases the gear meshing with Q contains almost double the teeth that Q contains. No. 86.

LXXXVII. CONE AND BOBBIN SPEEDS.

All persons that understand the law of mechanics know that the consumption of power required to drive a mechanism is much greater when the driving gear is larger than the driven. Such a condition is found on all new differential motions as was explained, that in order to

SPEED UP

gear Q, this speed must be obtained either by speeding the bottom cone or changing the ratio in the train of gears.

So the above is another reason why the ends will slacken more when starting any speeder suddenly equipped with the new motion than on a speeder equipped with the old motion with the differential sleeve seperated from the driving shaft.

Many carders have changed the starting point of the cone belt on speeders equipped with the new differential motion, in order to equalize the ratio of the two cones, and thus eliminate the slackness considerably at the beginning of the set.

The position of the belt is changed by changing the cone gear; for instance, suppose it is desired to change the position of the cone belt, owing to the small end of the cone being worn or for the reason stated above, from 7 inches diameter on the top cone to 5.25 inches diameter, what cone gear would be required? The end diameters of the cones on a slubber are respectively 7 inches and 3½ inches.

The full length of the cones, we will say, is 36 inches, and the top cone is making 210 revolutions per minute. Again, suppose that when the set of roving is completed the cone belt has travelled 25 inches, it can be seen that there is 11 inches available, and the cone belt can be shifted to that amount. Proceeding now to ascertain the speed of the lower cone for the stated two positions of the cone belt, we have the following calculations: (1) The first speed of the bottom cone would be: 210x7 divided by 3.5 equals 420. (2) After shifting the cone belt from 7 to 5.25 inches on the top cone, and from 3½ to 5.25 inches on the bottom cone, the revolutions of the bottom cone will be as below: 210x5.25 divided by 5.25 equals 210 revolutions of the

BOTTOM CONE.

Now we will assume that we have on the end of the bottom cone a 20 cone gear, so in order to drive the bottom 420 revolutions per minute as desired after the cone belt has been moved we have the following: 420 is to 210 what x is to 20 equals 40 cone gear. It must be understood that the position of the cone belt is seldom if ever changed to such an extent as given above, the distance and dimension of cones are simply given so that the reader can see it more clearly. The above is a rule, although simple, that has been wanted for a long time, because it does not only enable the reader to find the proper gear for a certain position of the belt, but he can by it also see that the two cones must be in line at all times, or the intermediate speeds will be affected. The reader should now understand that the surface speed of the front roll and the excess surface speed of the bobbin must at all times be equal, and that when the parts which give the excess speed; namely, the driven cone drum and its connections are stopped, the speed of the bobbin will be exactly equal to the speed of the flyer. It will be readily understood then that the speed of the bobbin is made up of two parts, that is, a speed equal to the speed of the flyer, and another speed equal to what we call the excess speed of the bobbin. The speed of the bottom cone with its connecting

GEARING CONTROLS

the excess speed of the bobbins, and receives no help whatever from the driving shaft as claimed by many

writers. So then the actual speed of the bobbins is decreased only by those parts of the machine governing the excess speed that have their own speed changed.

The reader should now see the importance of having all parts that the bottom cone governs cleaned often and well oiled, because the causes of uneven roving and yarn is generally due to dirty dry slides, dirty bobbin gears, dry bobbin gear from the want of oil, dirty bolsters, stuck spindles, dry lifting shaft from the want of oil, slides and journals not properly fitted, or the derangements of their parts, are all causes of a slack tension and too little attention has been given these parts, except by thoughtful and ambitious carders themselves. It should be seen that those parts governing the excess speed must be as free as possible, more so on all speeders equipped with any new differential motion, because with the extra resistance caused on the cone belt by the high speed cone arrangement combined with any of the above defects, a slack continuous tension would be the result.

Let us keep these parts well cleaned and oiled, so as to have an even tension throughout the set, and not have a slack tension which is the cause of the speeder tenders tightening their rack which makes

DISASTROUS WORK

on the warpers. We pointed out the effect that is caused on the surface speed of the bobbins when those parts governing the excess speed are neglected. No. 87.

LXXXVIII. TOP ROLLS.

Now, what bearing have top rolls on the subject? The proper care of top rolls is just as important as the winding-on problem, they must be kept clean. They must also be oiled well and kept free from any dirt which might tend to clogg them. When this is carefully attended to, the production is always larger and of a better quality.

If the top rolls are allowed to become dry and dirty, or if the saddles become badly worn, a resultant friction is caused on the top roll, which shortens the strand.

If the first and second rolls are not set far enough over the length of staple being run, a constant friction will be caused on the front roll. Too much twist in the strand fed will cause friction on the front rolls and the strand is shortened. If the roving delivered be examined, it will be found to contain thick and thin places. Any of the preceding evils tend to cause a constant pull on the strand, and this makes the surface speed of the bobbin unequal, because some rolls are perhaps in a condition to offer more resistance to the winding than others, with the result that we have two or more bobbins of different diameter running on the same frame, that becomes more troublesome as the bobbins increase in diameter, and in some cases, it is necessary to doff the frame. The

WEIGHTING OF TOP ROLLS

on speeders has lately been receiving considerable attention from textile schools and papers. This is because it has been discovered that top rolls not properly weighted or neglected are a greater evil and cause more bad work than neglecting the parts governing the excess speed, because as was pointed out when the tension becomes slack, owing to some resistance offered to the working parts of the excess speed, the only harm that is done is when the speeder tender tightens the tension, which of course, strains the ends for the time being. But as the tension has a tendency to become slacker, the strain on the ends is quickly removed, still it must be admitted that some bad work is made. As we have stated often, the tightening of the tension on speeders should be branded as a crime by every carder, and such a practice should not be tolerated. However, the evil caused is not as great as when the top rolls are not properly weighted or properly cared for.

As was stated elsewhere, when friction exists on any front top roll, the frictional contact creates a constant pull on the strands, thus stretching it in places as all frictional contacts are

always intermittent. The poor showing made by some mills making coarse yarns, that formerly made fine yarns has brought about this attention of roll weighting. It must be admitted that most all machine builders make

A GREAT MISTAKE

when they use the same weights for speeders built for a coarse mill that they recommend for speeders built for a fine mill. Of course, we do not advise that when a radical change is made on a speeder, say, from 20 hank to 4 hank that the weighting should be changed, because this would be very expensive. But if such a change is made, and it is found that the weighting is too light, which is detected by the strand having many light places here and there, the strand fed should be made lighter and run with as little twist as possible. One good remedy we have given elsewhere that will minimize the friction to a large degree, and is found to be such a benefit, we again explain here. When setting the top rolls, instead of using a square to square the surface of the top leather roll to the surface of the bottom steel roll, set the top leather roll a little forward of the centre of the bottom steel roll. It should be seen that when the top leather roll is set a little forward of the centre of the bottom steel roll, a firmer bite is created at that point, and thus the drawing qualities of the top leather roll are increased. When the top leather rolls are set exactly over the centre of the bottom roll, it will be noticed that when the frame is started or stopped a forward and backward movement is caused. When this happens, one side of the roll may make its forward or backward movement before the other side, thus making a little crimped place in the strand. Although such a defect in the strand does not

AFFECT THE RUNNING

of the work, it certainly gives the yarn a faulty appearance. So it should be seen that in order to have an even tension on the frame at all times, the top leather roll must be as free to revolve as possible, and the bottom cone must receive the least resistance possible. The observant overseer should, when making his rounds, detect any of the above conditions, because, when rolls are neglected, which destroy the relationship of the surface of the front roll and the surface speed of the bobbin, the pull on the strand causes the bobbin to be more compact, and consequently its diameter is reduced, which makes it of a different diameter than other bobbins, and in most cases the end is broken back and the bobbin removed. Sometimes speeder tenders will run an extra end at the back for a couple of layers or more in order to increase and make the diameter of the bobbin the same as all others. This is an evil that causes much damage to top leather roll in the ring-spinning and mule rooms, because when roving contains an extra doubling for a few yards, this portion is, of course,

HARDER TWISTED

with the result that it is too much for the front roll to draw, and if the roll is set a little forward of the centre of the roll, the roll will continue to revolve, and the leather covering in most cases is damaged to such an extent as to require recovering.

When bobbins are removed here and there, the carder should demand a reason, and not leave the frame until he is satisfied that the tension is right.

Another good sign to go by is when the tension is too tight, the ends will break at the eye of the presser, the majority on the back row of spindles. When the tension is slack, caused by the parts connected with the bottom cone not working freely, the ends will have a tendency to fly outward and "balloon" as it is called, and thus escape from the threading slot of the flyer. When an end breaks and is not detected by the tender, until the traverse has travelled the length of the bottom, and after piecing this end, it escapes from the thread slot of the flyer, it indicates that the tension is too slack. Sometimes all of the above conditions are due to careless sizing or in the neglecting of sizing of the sliver or roving. No. 88.

LXXXIX. UNEVEN WORK.

Uneven work will cause a hard and soft bobbin. The end being wound around the presser a different number of times, or allowing the eye and hollow leg of the flyer to become clogged with dirt, will cause bobbins of different diameters. The most important points tô watch in the care of fly frames is the making of what are technically known as single and double. Single is caused when one end running two into one is broken, and the single end is allowed to run for a few layers, when the end is pieced again without unwinding the defective roving. Double is caused by the broken end in the above case, joining with the two other ends running along side, making three ends running into one. Double is also caused by the broken ends in the front running in with other ends. There should be no excuse for making single or double. If the tender blames the operative in the previous process for sending bad work, the situation should be investigated. If a speeder tender is making double or single and allowed to do so, the overseer is to blame. When speeder tenders make bad work, they know it, and they should

STOP THE FRAME

and unwind the defective roving from the bobbin. Many overseers will say that it is impossible to stop all the single and double. We are willing to admit that accidents will happen, for instance, a passer-by may strike a roving and cause it to fall to the floor, and as soon as it is discovered it may be pieced by some-one other than the tender, thus causing single that is not detected by the tender. Such cases happen very seldom—perhaps once in a month, and it is a very weak argument for an overseer that allows his speeder tenders to make a box in some cases two boxes of bad roving in a week. Single and dŏuble can be traced to the cloth and in most cases is the cause of much worry to the man at the helm, especially on window shade cloth, where the defects in a single thread can be detected. Again, when three ends run into one and they are allowed to go through every process, they will become flattened in the slasher and the product will appear more bulky than it really is. This gives the cloth a very bad appearance.

Another bad defect found in many card rooms is bobbin gears jumping here and there, which is caused by the gears being very dirty or not properly set. When bobbin gears are allowed to jump much breaking back is caused in the ring spinning and mule rooms, because when bobbin or spindle

GEARS JUMP,

it causes the coils to over-ride one another as they are wound on the bobbin, and when the bobbin is unwound at the next process the part of the coil that is receiving a pull from the back rolls may be under another coil which in most cases causes the roving to break back.

When a radical change is made in the number of the yarn to be spun, it becomes necessary in some cases to make a considerable change in the hank roving.

When any considerable change is made in mills, it is a custom among most carders to run one-half of the old roving with one-half of the new roving, a practice that causes much trouble in after processes, especially if there is a variation in the length of the staple. When a change is made from coarse to fine work, the only and best way is to change the back roving when the frame is doffing so that all the piecings made at the back from changing the roving will be wound on the beginning of the bobbin, which is generally pulled off at the next process when creeling. The best way in changing roving is instead of having the ends of the old roving projecting from the back roll to have them project or hang over the rods. This will save much trouble for various reasons, (1) the trouble of putting every end over the rods is eliminated, (2) the front row of roving is separated from the back row, and the liability of getting the

front row mixed with the back rows is not as great, (3) the ends that

SHOULD BE PIECED

to the half bobbins, and the ends that should be pieced to the full bobbins can be more readily picked out. When all these little items are considered in a mill where much changing is done, much labor and expense will be saved, because breaking out is an expensive process at best, and if properly done, much production is saved. A great mistake that some builders of machinery are making is in making the space in the creel wide enough to enable the speeder tenders to put two full rovings in together. We know of no other practice that is more detrimental to the making of an even yarn. Let us suppose that the mixing has the opposite qualities of the old mixing, and the work comes in much lighter, say, on the slubber where .60 hank should be made, we are now making .63 (which is not much of a variation for slubber roving) and instead of creeling one full bobbin with a half-full bobbin of the old roving, we creel the two rovings together, so that it can been seen from the following example, that it is detrimental to the making of an even yarn. In the first case, .60 hank roving fed in (2 into 1) equals .60 divided by 2 equals .30 hank; in the second case, .63 hank roving fed in (2 into 1) equals .63 divided by 2 equals .315. We next find the variation that such a change in the slubber roving will make in the intermediate not considering the twist: .30 hank roving makes 1.60 hank roving on the intermediate. For the convenience of

CALCULATION

we will use the following method to show that although the variation may appear to be slight, it is increased at every doubling process. 1.60 divided by .30 equals 5.33, draft of intermediate. 1.60 divided by .315 equals 5.07 or slightly over a quarter hank. It should be seen that if the builders would have

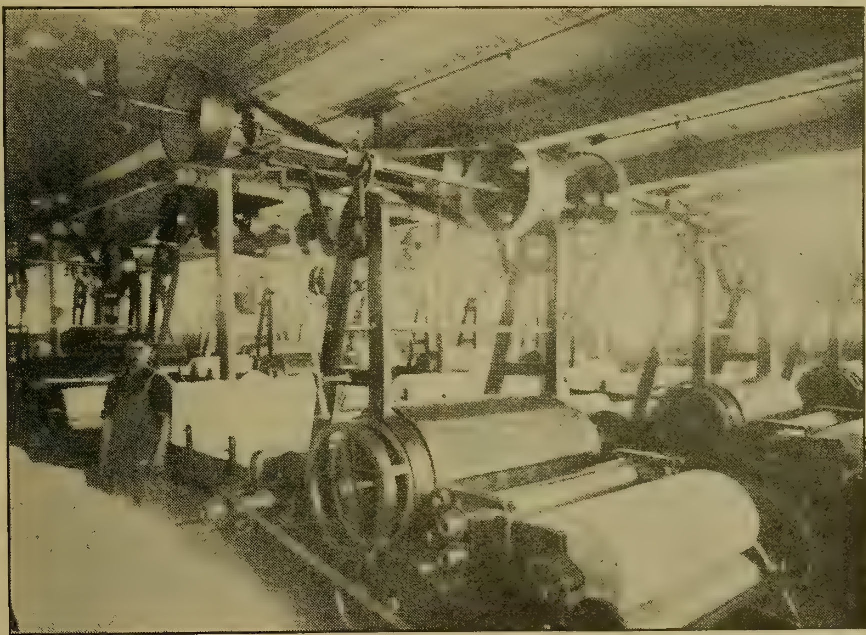


Fig. 34. View of Picker Room in a New England Mill.

just space enough to allow only a half and full bobbin to be put in together at the same time, such variations would seldom if ever exist. It should be the aim of every carder to have as little creeling as possible, and the only way to reduce the amount of creeling is to have a properly filled bobbin. No. 89.

XC. BOBBIN TROUBLES.

When the bobbins are not properly filled, much dissatisfaction is caused among the operatives; also if a bobbin is not constructed with as great a traverse as possible with the least taper on the bobbin (which should be about 30 degrees) and filled to gauge of the flyer, more doffing and creeling is caused. In the first case, few doffers care to work where the speeders are continually doffing, so the result is that where such conditions exist there is also a continual shortage of doffers. In the second case, more creeling is caused which means more work for the speeder tender, and they too care little to work where the back roving comes out often, so we are also short of speeder tender. Besides more creeling means more waste, because all mill men will agree with the writer that there is always a certain amount of roving pulled off each bobbin

AT EVERY CREELING,

which, besides making waste that must be run over again, makes the work run badly. It must be remembered too that the roving being pulled off has been paid for and when a large amount is sent to the picker room, it is quite an expensive item. This frequent creeling has been the cause of many speeder tenders cutting the layers on the bobbins instead of pulling them off, thus spoiling the staples of the cotton that is cut beside cutting the bobbin which causes it to splinter and become troublesome at each creeling time. The best of care should be given to the bobbins; they should never be allowed to remain on the floor, or allowed to remain in the bottom of roving boxes and roving doffed over them, because many bobbins are broken under such conditions. Neglecting the skewers causes much breaking back at times, especially on a very warm day and when the air is full of humidity, some mills on such days having much trouble from the roving breaking back. When the skewers become very dull, they should be sharpened and examined from time to time. If they are found to have been sharpened often, they should be replaced with new ones. It is often that an extra tootn of twist is inserted in the roving or yarn—the cry being that the new cotton is coming in and requires more twist, when

THE REAL TROUBLE

is the condition of the day acting on the skewers, which are in bad shape. Here is a point we wish to give the young carder. Do not always have that excuse of new cotton, because it is a confession of your weakness in not knowing how to run a room. New cotton, as a rule, will lose much more, because it is in most cases a little green, or in other words, full of moisture, and when such a cotton will dry out somewhat in going through, the slivers are made lighter and, as we have stated, if the drawings are sized twice daily, such variations are quickly detected, and the gears on the finished drawing should be changed until the same standard weight sliver is established. Mix the new cotton with the old if possible, because the loss will not be as great, but of course, the staple must be the same length. No. 90.

XCI. HUMIDITY.

New cotton will lose from 12 to 7½ pounds to the bale, while the old cotton will lose from 3 to 7.5 pounds to the bale. This is much misunderstood by most mill men. We know of cases where the hoops and bags and every particle of matter was weighed and when it was found that the loss was so great, the treasurer and superintendent came to the conclusion that the cops and cop waste were taken

from the mill. If a mill uses 100 bales of cotton in a week, and eight pounds of humidity is lost

IN EVERY BALE,

which is usually the case, we have 9x 100 equals 900 pounds of cotton that we are unable to account for. To prove that the above is true, take out a sample of new cotton, say, about a pound, and let it stand anywhere about the room, and it will be found to be much lighter—the best way is to put the sample on a scale so as to just balance it, because if a person stands and watches the scales it will soon be clearly realized that the moisture leaves the cotton very rapidly. The reason why we advise mixing new cotton with the old, is simply because sometimes cotton is picked from the balls that are not well opened, and such cotton is much weaker, and it is well known that cotton that is opened for a day or more increases in strength, but it must be understood that if it is sunned any length of time it is much weakened. So it can be seen that when the new cotton is mixed with the old, there is everything to gain, because the old cotton helps the weakness of the new cotton, and the loss in humidity is only about one-half. It must not be forgotten that the atmospheric conditions are not considered above. A lesser or an increased degree of moisture means a lighter or heavier strand. So if an overseer running any room is unfortunate and has

NO HUMIDIFIER,

he must be a good judge of atmospheric conditions in order to be able to keep the section beams at their proper weight. Only experience, good judgment and diligent study will enable him to do this.

Why some mill men are against the use of humidifiers, the writer fails to understand, because it must be admitted that a certain amount of humidity is necessary in textile working. Again, it should be seen by such mill men that it is unfair for them to demand the same speed and production from their overseers that is obtained by overseers enjoying the use of humidifiers. The best natural conditions for textile working is generally admitted by most mill men to be found in the month of June in the New England states, when the average temperature in the mill registers 75 to 80 dyegrees Fahrenheit, with a relative humidity of 55 to 65 per cent, and absolute humidity 5 to 6 grains of moisture per cubic foot of air. This is the very reason why it seems to the writer strange after these men have learned by experience that during part of the year, everything works well and smoothly, while at other times, there is trouble and plenty of it too. Surely every mill man wants to produce at all times the same conditions found in that certain part of the year. To do this, he should realize that it is essentially a matter of

ARTIFICIAL MOISTENING

of the atmosphere. Another fact in favor of the use of humidifiers is that slightly moist material works more smoothly than when dry or too wet, for the reason that the fibres are more flexible and coherent, when properly moistened. The securing of a larger production of a better quality is not the most effective argument for the use of humidifiers in any cotton mill, for the up-to-date mill man knows full well that they conduce to the comfort and health of the operatives. No one can deny that the New England manufacturers have been pioneers in this country in recognizing the dollars and cents value of working conditions, but it seems that they cannot see where the humidifiers will not only pay for themselves in a short time but give a larger and better production for ever after. Adequate ventilation is as vital a factor in summer as in winter, and in order to secure a uniform product, the material must be worked under uniform conditions, from the card to the loom. Humidity does not only count in the working of the material, but fully as well in the working of the machinery. A little thinking on the part of any

mill man should be enough to convince him that a card that works well in an atmosphere of 60 per cent of relative humidity, would be a constant source of annoyance when

THE HUMIDITY FALLS

to 40 per cent. If humidity was understood by most mill men, a larger amount of humidifiers would be in use, because from the following it should be seen that atmospheric conditions change daily and the work is somewhat affected.

There is always two maxima of pressure which occur daily when the temperature is about at the mean of the day, and two minima when it is at its highest or lowest respectively. There is thus suggested a connection between the daily barometric oscillations and the daily march of temperature; and similarly a connection with the daily march of the amount of vapor and humidity of the air. The cause given for the above is that the forenoon maximum is due to the rapidly increasing temperature, and the rapid evaporation owing to the great dryness of the air at this time of day, and to the elasticity of the lowermost stratum of air which results therefrom, until a steady ascending current has set in. As the day advances, the vapor becomes more equally diffused upward through the air, an ascending current, more or less strong and steady, is set in motion, a diminution of elasticity follows, and the pressure falls to the afternoon minimum.

From this point the temperature declines, a system of descending currents sets in, and the air of the lowermost stratum approaches more nearly the point of saturation, and from the increased elasticity, the pressure rises to the evening maximum. As the deposition of dew proceeds, and the fall of temperature and consequent downward movement of the air are arrested, the elasticity is again diminished, and pressure falls to the morning minimum. No. 91.

XCII. SPINNING CALCULATIONS.

For the benefit of those who have a practical experience and do not understand how to equip or calculate the necessary drafts to obtain a certain amount of pounds, and at the same time one process to keep up with another on coarse, medium and fine work, the following is given:

Let us suppose that a mill is equipped with 20,000 warp spindles and 19,000 mule spindles. The number of the warp yarn is 28s, and of the filling yarn 42s. A warp spindle on 28s yarn will turn off about 1.3 pounds per spindle per week of 56 hours. Hence, 1.3x20,000 equals 26,000. There is much waste made, such as roving waste, clearer waste, etc., that must be allowed for. The amount of waste made in a ring spinning room of the above size is usually about 500 pounds which would make a total of 26,500 that must be turned off the fly frames. The amount of waste made in the mule room is about the same, because the back boys will cut off more roving than the spinners. This is because they put in roving only and do no piecing. A mule spindle on 42s yarn will turn off about .70 pound per spindle per week of 56 hours, hence, 19,000 x .70 equals 13,300 pounds and 500 allowed for waste equals 13,800 pounds that must be turned off the jack frames. The next thing to do is to obtain a catalogue from the builder of the machines, and see how many hanks it is possible to turn off with the speeders. Let us assume that we have 4.5 hank roving for the warp, and 6.5 hank for the filling, which is about the proper hank, so that a short draft can be maintained on the ring frames and mules. Suppose we take the Howard and Bullough catalogue and we find that a fly frame when running 4.5 hank roving will turn off 8.33 hanks per day or about 45 hanks for a week of 56 hours. The next thing to do is to find how many pounds one spindle will produce in a week of 56 hours. In order to make it clear to the reader, the following method is offered to show how easily the pounds per spindle can be calculated for any length of time. Assuming that we are running 4 hank roving on a

frame of 160 spindles, it will take 4 hanks to make a pound on the spindle, so if 4 hanks make one pound on the spindle, and the frame turns off only one hank, we have only .25 pound on the spindle, or .25x160 equals 40 pounds on all spindles. The best method to

OBTAIN THE PRODUCTION

is to first find the constant, that is, the total amount of roving that is on all the spindles when the frame turns off one hank.

It can be seen from the above that, if we divide the hank roving into the number of spindles, we obtain the amount of roving on all the spindles when the clock has registered one hank: 160 divided by 4 equals 40.

We want to find what one spindle will turn off, so we divide 4 hank roving into one spindle which gives us the amount of roving on one spindle when the clock has registered one hank: 1 divided by 4 equals .25.

To prove the above we go back to the Howard and Bullough catalogue and we find that a spindle on 4.5 hank with the front roll making 128 revolutions per minute turns off 185 pounds per day. Using the above rule we have: 1 divided by 4.5 equals .222x8.33 hanks equals 1.8492 or 1.85 pounds per spindle.

As was stated the frame will turn off about 45 hanks per week. So in order to find the necessary number of fly frame spindles to turn off 26,500 pounds of finished roving, we multiply the constant of one spindle which in this case is .222x45 equals 9.99 or 10 pounds per week. 26,500 divided by 10 equals 2,650 spindles required.

So we divide 2,650 by 14 which is the number of speeder spindles intended, which equals 189 spindles per speeder, so we make it 190 spindles per speeder.

To prove the above short method in obtaining production we now get the total number of spindles which is 14 x190 equals 2,660.

One spindle turns off nearly 10 pounds, so we have 10x2,660 equals 26,600 pounds turned off on all the spindles in 56 hours. Now if one frame will turn off 45 hanks, two frames will turn off 90 hanks and 14 frames will turn off 7x90 equals 630, total number of hanks. 190 divided by 4.5 equals 42.22, constant for obtaining production. 42.22x630 equals 26.5986 or 26,600 pounds turned off on all the spindles in 56 hours. We next find the number of jack spindles required to turn off 13,800 pounds of finished roving.

Using the above rule we have: 1 divided by 6.5 equals .1538 or nearly .154 for a constant. We refer again to the catalogue on the same page, and we find that a frame running 6.5 hank roving,

THE FRONT ROLL

making 106 revolutions per minute, will turn off 7.15 hanks per day or about 39 hanks per week of 56 hours. 39x.154 equals 6.006 or 6 pounds per week. 13,800 divided by 6 equals 2,300 jack spindles required. 2,300 divided by 12 equals 191 number of spindles per frame, so we call it 192, an even number, as on the fly frames, because the spindles must be of an even number in order to have the same number of spindles in each row.

Again, we prove the above rule as in the case of the fly frames. 12 frames at 192 spindles: 12x192 equals 2,304 spindles; 2,304x6 pounds equals 13,824 pounds turned off on all the spindles in 56 hours. If one frame turns off 39 hanks two frames will turn off 78 hanks and 12 frames will turn off 6x78 equals 468 hanks. 192 divided by 6.5 equals 29.53 constant. 468x29.53 equals 13,819 pounds turned off on all the spindles in 56 hours.

No. 92.

XCIII. FURTHER SPINNING CALCULATIONS.

We next find the necessary number of intermediate spindles to give the above production on warp and filling. An allowance must also be made here, for cut roving clearer waste, etc., which in this case we will assume to be 500 pounds on the warp and 350 pounds on the filling.

So we must turn off 27,100 pounds of intermediate roving from the warp intermediates, and 14,174 pounds of intermediate roving from the filling intermediates. We have

RECOMMENDED

elsewhere 1.65 hank intermediate roving for 4.5 hank roving. We refer again to the Howard and Bullough catalogue and we find that an intermediate will turn off 9.85 hanks per day or 54 hanks per week of 56 hours, the front roll making 140 revolutions per minute. We next get the constant production of one spindle. 1 divided by 1.65 equals .606x54 equals 32.72 pounds turned off one spindle. 27,100 divided by 32.72 equals 828, number of spindles required for warp intermediate. 828 divided by 103.5, calling it 104 spindles per frame; 8x104 equals 832x32.72 equals 27,223 pounds turned off on all warp intermediate spindles. Using constant 104 divided by 1.65 equals 63.03 constant. 54 hanks turned off one frame 8x54 equals 432 total hanks turned off. 63.03x432 equals 27,228 pounds turned off on all warp intermediate spindles.

We will call the intermediate roving for the jack frames 2 hank. We refer again to the catalogue and we find that an intermediate will turn off 10.42 hanks per day or 57 hanks per week of 56 hours, the front roll making 132 revolutions per minute. We then get the constant production for one spindle: 1 divided by 2 equals .5x57 equals 28.5 pounds turned off one spindle. 14,174 divided by 28.5 equals 498 spindles required on the filling side; 498 divided by 6 equals 83 to a frame, call it 84 spindles. It is not necesary to take up any more space in explaining how to find the number of spindles for a certain production, because the numerous examples given should be sufficient to give a clear understanding of the above method in finding the production for one or more spindles, for any period run.

We must next find the necessary number of slubber spindles for both warp and filling. There is some loss here also, which we will assume in this case is 200 on the warp slubbers, and 100 on the filling, thus the warp slubbers must produce 27,460 pounds of warp slubber roving, and 14,274 pounds of filling slubber roving. We make the warp slubbers .60 hank and the filling .65 hank.

We refer again to the catalogue and we find that a slubber making .60 hank roving will turn off 11.17 hanks per day, the front roll making 173 revolutions per minute. 11.17 hanks per day is equal to about 61 hanks per week of 56 hours.

We then get the constant production of one spindle: 1 divided by .60 equals 1.666x61 equals 101.63 pounds off one spindle. 27,460 divided by 101.63 equals 270 spindles required on the warp side. 270 divided by 3 equals 90 spindles on each slubber. 101.63 x270 equals 27,440 pounds turned off. Using constant, we have: 90 divided by .60 equals 150x183 total hanks equals 27,450 total production. The difference of ten pounds is lost in the fractional part owing to the bulk of the strand. We now find the number of spindles on the filling side. Referring again to the catalogue, we find that a slubber making .65 hank roving the front roll making 165 revolutions per minute turns off 10.92 hanks per day or 60 hanks per week. 1 divided by .65 equals 1.538 constant, 1.538x60 equals 92.28 pounds off one spindle. 14,274 divided by 92.28 equals 154 spindles required. 154 divided by 2 equals 77 spindles on a slubber, call it 78 spindles on each slubber.

Thus, 92.28x156 equals 14,395 pounds. Using the constant, we have: 78 divided by .65 equals 120 constant. 2x60 total hanks. 120x120 equals 14,400 pounds. We have said elsewhere that as a general rule, it is not always possible to arrange a series of fly frames so as to

GIVE THE BEST

theoretical drafts, because one process must keep up with another, and at the same time have the same num-

ber of spindles on each kind of frame. In the above calculations we have 8 intermediates containing 94 spindles and 6 containing 84 spindles. This would be a poor arrangement, because the frames would have different lengths. When equipping a mill the slubber and intermediate should if possible consist of the same number of spindles, and the production of the different processes balanced by properly arranging the drafts. This will be explained fully when we calculate from the top to the yarn. We next find the number of deliveries, but in so doing, what we have said about the greatest amount of friction being between the first and second roll on the slubber must not be forgotten.

The slubber draft must be as short as possible, and the drafts in the intermediate frames should be less than the draft in the roving frame and slightly greater than that of the slubber. In other words, the draft at each process should be increased as the diameter of the strand fed in at the back decreases. Such an arrangement of drafts reduces the amount of friction found too often in most cotton mills, which to a large degree is the cause of uneven yarn, besides wearing the leather rolls.

In order then not to have the drafts in the fly frames excessive, the finished drawing sliver must be as light as possible. There is loss between the slubbers and drawings, which although very slight should be taken into consideration. N. 93.

XCIV. PRODUCTION.

We will now consider the total production together with 100 added for the loss between the slubbers and drawings. 27,460 plus 14,400 plus 100 equals 41,960 total production. A 50-grain sliver to the yard will necessitate a draft of about 3.87 on the filling slubber. A 60-grain sliver to the yard will necessitate a draft of about 4.35 on the warp slubbers, which we consider a long draft, which was proven elsewhere. In order to turn off 41,960 pounds with the loss again considered 60 cards are required. We have advised elsewhere to have a delivery of drawing for each card. So in order to find the number of pounds one delivery

SHOULD TURN OFF,

we divide the number of deliveries intended into the total production: 41,960 divided by 60 equals 699 or 700 pounds each delivery must turn off. In order to find the speed of the front roll, the constant for production must be found if the shortest method is desired. To find constant for production on a drawing frame, multiply the circumference of the front roll by the minutes run, divide by 36 and 840 and the quotient will be the constant.

EXAMPLE.

Diameter of front roll 1⅜ inches equals 4.3197 circumference. 60x56 equals 3,360 minutes in a week of 56 hours. 4.3197x3,360 equals 14,514 divided by 36 equals 403.17 divided by 840 equals .48 constant.

Rule to get production with the above constant: (1) find the hank sliver and divide into constant, (2) multiply this quotient by the revolutions of the front roll, and the quotient will be the number of pounds from one delivery 100 per cent.

A certain per cent must be deducted from the production found in order to get the actual production. This loss varies much, it depending on the speed of the machines, the weight of the sliver, kinds of help, the number of deliveries, run by one person, etc., 15 per cent being about the average loss. 8.33 divided by 50 equals .166 hank sliver filling side; .48 divided by .166 equals 2.9. 700 divided by 2.9 equals 241 revolutions of the front roll. Deducting 15 per cent, we have 241x.85 equals 205 revolutions of the front roll. 8.33 divided by 60 equals .138 hank sliver warp side. .48 divided by .138 equals 3.48; 700 divided by 3.48 equals 201x.85 equals 171, speed of the front roll. So we have 30 deliveries of drawings turning off about 21,000 pounds with the front roll

making 343 revolutions per minute and 30 deliveries turning off about 21,000 pounds with the front roll making 201 revolutions per minute. We next consider the combers.

The production of

A COMBER VARIES,

but for the convenience of calculation we will assume that the comber takes off 400 pounds, adding a slight loss to the production under consideration, which makes the total production 42,000 pounds. 42,000 divided by 400 equals 105 combers required. Like the comber the production of the ribbon lap machine varies also, but is about 600 to 1,000 pounds per day.

We assume in this case that the ribbon lap machine is to turn off 700 pounds per day, or 3,850 a week. Counting no loss we have 42,000 divided by 3,850 equals 11 ribbon lap machines required. The production of a sliver lap machine is, as a general rule, a little less than the production of the ribbon lap machine, say about 450 to 900 pounds per day; again, assuming that the sliver lap machine is to turn off 600 pounds per day or 3,300 pounds per week. Counting no loss we have 42,000 divided by 3,300 equals 13 sliver lap machines required.

The number of cards necessary has already been given, and it must be understood that the weight of the sliver on the card should be the same as the finished drawing. As the production of an intermediate or finisher picker varies from 10,000 to 13,000 pounds per week, it can easily be seen that for the above equipment 4 intermediate and 4 finisher pickers are required.

The production of an automatic feeder and breaker combined varies from 20,000 to 25,000 pounds per week, and three feeders are sufficient for the above equipment. We will now give all calculations necessary in starting a new mill from the picker to the fine and jack frames. No. 94.

XCV. DRAFTS, TWISTS AND CONSTANTS.

We will next give three charts showing the equipment, and gearing such as the draft constants, drafts, twist constants, twist per inch, coils to the inch, lay constant, and lay gear and speed calculation, etc. We will calculate the medium mill, so that any student can from the charts, ruler and explanations given, calculate any change to be made in any cotton mill.

The first consideration is the speed of the beater. Assuming that the counter-shaft is making 480 revolutions per minute, and carrying a pulley 24 inches driving a pulley on the beater of 8 inches diameter, we have: 480x24 divided by 8 equals 1440 speed of beater. We next consider the blows to the inch. Diameter of feed roll 2½ inches, speed of feed roll 9.9 revolutions per minute, speed of beater 1,440, number of blades 2; 2.5x 9.9x3.1416 divided by 2x1,440 equals 37 blows struck to the inch of lap delivered by the feed rolls. We have said elsewhere that the drafts in the picker room should not be considered, but instead to consider the blows to the inch. When more production is required, speed up the feed on all the machines. In speeding the feed, no chances are taken, because the faster the feed the less the blows to the inch.

To find the hank lap, the following rule may be used to advantage. Rule: to find the hank of lap, roving or yarn, divide 12 in as many hundreds as you take yards, and the quotient will be the constant for that number of yards. For instance, suppose we wish to find the hank of a lap weighing 11 ounces to the yard, we would first find the constant for one yard. Using the above rule we have 100 divided by 12 equals 8.333 constant for one yard. There are 437.5 grains to the ounce, so to find the hank we must first reduce the ounces to grains: 11x437.5 equals 4812.5 grains; 8.333 divided by 4812.5 equals .0017 hank lap. Again, to give a clear understanding of the above method, we will suppose that we reel off 48 yards of roving, weighing 90 grains. Using the above method we have, 48x100 equals 4800 divided by 12 equals 400

constant. 400 divided by 90 equals 4.44 hank roving.

We have now

REGULATED OUR FEED

in the picker so that the cotton is receiving 37 blows to the inch, and the finished lap is weighing 11 ounces to the yard.

We now find the draft of the card on the filling side to make a 50 actual grain sliver. It must not be forgotten here, that 4½ per cent must be allowed for the foreign matter extracted from the lap while passing through the card, such as fly, seeds, and strips. So we multiply the grain sliver by the loss and we have, 1.045x 50 equals 52.25. 11x437.5 equals 4812.5 grains. 4812.5 divided by 52.25 equals 91 draft of card. We refer again to the Howard and Bullough catalogue and we find the draft constant 1604.95. 1604.95 divided by 91 equals 17.6 or 18 draft gear. We next calculate the draft of the warp cards. 1.045x60 equals 62.7. 4812.5 divided by 62.7 equals 77 draft of warp card. 1,604.95 divided by 77 equals 20.8 or 21 draft gear.

We next find the drafts on each process of drawings to give a 50-grain finished sliver on the filling side, and a 60-grain finished drawing sliver on the warp side, 6 doublings at each process. We now employ the rule given elsewhere, which is repeated here. To get the draft on each head of drawing of each process, multiply the hank desired by the doublings and divide by the hank carding, extract the cube root from the quotient and the result will be the draft there should be on each head of each process.

Example: 6x6x6 equals 216 total doublings; 216x.166 divided by .166 equals 216; cube root of 216 equals 6 for the draft.

To prove the above calculations, we will employ a different method. 6x6x6 equals 216 total draft. 6x6x6 equals 216 total doublings. 216 (total draft) x.166 hank carding equals 35.856 divided by 216 (total doublings) equals .166 hank finished drawing. We again refer to the Howard and Bullough catalogue and we find the drawing draft constant, 383.34 divided by 6 equals nearly a 64 draft gear. It is useless to figure the drafts on the warp drawings, because it should be seen that if the weight of the finished drawing sliver is the same weight as the carded sliver the calculation will be the same as given above and the same drafts and gears must be employed at each head.

Again it must be understood that we do not advocate a 60-grain sliver on the cards for the hank roving mentioned, for the above weights are given simply to make it clear to the beginner how to go about making a different hank sliver. We have said elsewhere, while calculating the number of deliveries, that 30 deliveries would turn off 21,000 pounds of filling drawing, and 30 deliveries would turn off 21,000 pounds of warp drawing. In such a case where a different weight sliver must be made on the finished drawings, the weight required must be balanced by changing one head of drawing on the warp side. In finding the number of spindles for the intended production on the slubbers it was found that 3 slubbers consisting of 90 spindles were necessary on the warp side, and 2 slubbers consisting of 78 spindles on the filling side, which makes a total of 426 slubber spindles.

No. 95.

XCVI. SLUBBERS, INTERMEDIATES AND JACK FRAMES.

As was stated, all the slubbers should be of one length. If we divide 426 by 6 we have 71 spindles to a slubber; make it 72 and proceed to find the proper draft to give the intended production. As on the drawings, one filling slubber should be changed from time to time to balance the production of warp and filling. We now calculate the draft of the filling slubber: .65 divided by .166 equals 3.91, draft of filling slubbers.

We again refer to the catalogue and we find the slubber draft constant to be 208 divided by 3.91 equals 53 draft gear. We next calculate the draft on the warp slubbers: .60 divided

Machine.	Number of frames.	Weight of lap and sliver.	Hank.	Revolution of card cylinder.	Revolution of doffer.	Draft.	Draft gear.	Twist per inch.	Twist gear.	Twist constant.	Lay constant.	Lay gear.
Chart No. 1:—												
Automatic feeder		11 oz.	.0017									
Automatic breaker	3	11 oz.	.0017									
Inter. and finisher	4	11 oz.	.0017									
Filling card	20	50	.166	165	12	91	18					
Warp card	40	60	.138	165	12	77	21					
Filling drawing	15	50	.166			6	64					
Warp drawing	15	60	.138			6	64					
Filling slubber	3	12.8	.65			3.91	53	.81	60	48.17	72	12
Warp slubber	3	13.8	.60			4.35	48	.78	62	48.17	72	12
Filling intermediate	6	4.16	2.00			6.15	38	1.56	37	57.90	200.4	15
Warp intermediate	8	5.04	1.65			5.50	43	1.41	41	57.90	200.4	18
Fine speeder	14	1.85	4.50			5.50	43	2.55	45	113.87	350	15
Jack frame	10	1.25	6.50			6.60	47	3.05	37	113.87	350	11
Chart No. 2:—												
Automatic feeder		11 oz.	.0017									
Automatic breaker	3	11 oz.	.0017									
Automatic finisher	4	11 oz.	.0017	165	12							
Warp and filling card	60	60	.138			91	18					
Warp and filling drawing	30	60	.138			6	64					
Warp and filling slubber	6	13.8	.60			4.35	48	.93	62	48.17	72	12
Warp intermediate	6	5.55	1.50			5	47	1.47	43	57.90	200.4	19
Filling intermediate	6	5.2	1.60			5.33	44	1.52	38	57.90	200.4	18
Filling fine speeder	12	2.08	4.00			6	39	2.40	47	113.87	350	17
Warp fine speeder	10	1.66	5.00			6.25	38	2.68	42	113.87	350	15
Chart No. 3:—												
Automatic feeder	3	10 oz.	.0019									
Automatic breaker	3	9.5 oz.	.0020									
Inter. and finisher	4	9 oz.	.0021									
Filling card	40	30	.277	165	9	130	12					
Warp card	40	40	.208	165	10	94	17					
Sliver lap machine	11	250	.033			2.24	29					
Ribbon lap machine	10	250	.033			6	49					
Filling comber	49	42	.198			25	23					
Warp comber	73	48	.17			29	20					
Filling drawing	12	30	.277			6	64					
Warp drawing	15	40	.208			6	64					
Filling slubber	3	8.3	1.00			3.62	57	1.20	48	48.17	72	10
Warp slubber	3	10.3	.80			3.86	54	1.07	60	48.17	72	12
Filling intermediate	6	3.03	2.75			5.5	43	2.01	25	57.90	200.4	13
Warp intermediate	8	3.79	2.20			5.5	43	1.78	30	57.90	200.4	14
Filling 2d intermediate	14	1.16	7.53			5.55	43	3.29	35	113.87	350	10
Warp 2d intermediate	16	1.37	6.05			5.55	43	2.94	40	113.87	350	11
Warp jack frame	46	.55	15.10			5.07	47	4.65	24	113.87	500.6	10
Filling jack frame	44	.4	20.30			5.48	43	5.37	21	113.87	500.6	9

Machine.	Number of frames	Coils to the inch.	Diameter front roll.	Revolution front roll.	Constant for production.	Revolution of spindles.	Hanks turned off.	Gauge.	Number of spindles.	Nips per minute.	Production.	Draft Constants.
Chart No. 1:—												
Automatic feeder												
Automatic breaker	3										43,000	
Inter. and finisher	4										42,500	
Filling card	20				9.076						19,680	
Warp card	40				9.076						23,670	1604.95
Filling drawing	15		1⅜"	343	.4971						18,450	1604.95
Warp drawing	15		1⅜"	201	.4971						26,239	383.34
Filling slubber	3	6	1¼"	165	110.76	630	180	12" x 6"	72		19,937	208
Warp slubber	3	5.8	1¼"	173	120	630	182	12" x 6"	72		21,840	208
Filling intermediate	6	13.43	1¼"	132	51	850	313	10" x 5"	102		15,963	236.88
Warp intermediate	8	11	1¼"	140	61.81	850	420	10" x 5"	102		25,960	236.88
Fine speeder	14	22.27	1⅛"	128	41.83	1,150	644	7" x 3½"	186		26,616	236.88
Jack frame	10	31.86	1⅛"	120	32	1,300	433	6" x 3"	208		13,856	312
Chart No. 2:—												
Automatic feeder												
Automatic breaker	3										46,000	
Automatic finisher	4										45,500	
Warp and filling card	60				9.076						45,340	1604.95
Warp and filling drawing	30		1⅜"	250	.4971						45,900	383.34
Warp and filling slubber	6	6	1¼"	173	120	630	240	12" x 6"	72		43,680	208
Warp intermediate	6	10.41	1¼"	147	.68	850	336	10" x 5"	102		22,848	236.88
Filling intermediate	6	10.75	1¼"	142	63.75	850	328	10" x 5"	102		20,910	236.88
Filling fine speeder	12	20	1⅛"	136	46.5	1,150	572	7" x 3½"	186		26,598	236.88
Warp fine speeder	10	23	1⅛"	121	37.2	1,150	437	7" x 3½"	186		16,256	236.88
Chart No. 3:—												
Automatic feeder	3											
Automatic breaker	3										32,820	
Inter. and finisher	4										32,816	
Filling card	40				9.076						11,880	1604.95
Warp card	40				9.076						18,800	1604.95
Sliver lap machine	11				1.745						32,560	64.482
Ribbon lap machine	10				1.745						33,840	296.25
Filling comber	49									85	11,858	589.47
Warp comber	73									90	18,834	589.47
Filling drawing	12		1⅜"	300	.48						12,356	383.34
Warp drawing	15		1⅜"	300	.48						20,700	383.34
Filling slubber	3	8	1¼"	148	84	700	168	11" x 5½"	84		14,112	208
Warp slubber	3	6	1¼"	166	105	700	165	11" x 5½"	84		17,325	208
Filling intermediate	6	16	1¼"	146	37.45	1,050	300	9" x 4⅝"	102		11,235	236.88
Warp intermediate	8	14	1¼"	136	46.66	950	424	9" x 4⅝"	102		19,783	236.88
Filling 2d intermediate	14	34	1⅛"	99	23.37	1,150	490	7" x 3½"	176		11,451	236.88
Warp 2d intermediate	16	31	1⅛"	111	29	1,150	640	7" x 3½"	176		18,560	236.88
Warp jack frame	46	48	1⅛"	79	13.7	1,300	1,380	6" x 3"	208		18,906	236.88
Filling jack frame	44	56	1⅛"	69	10.2	1,300	1,118	6" x 3"	208		11,668	236.88

by .138 equals 4.34 draft. 208 divided by 4.34 equals nearly 48 draft gear. We next calculate the twist per inch that should be inserted. Using the constant already given we have: the square root of .65 equals .806x1 constant equals 81 turns per inch.

Refering to the catalogue, we find the twist constant to be 48.17 divided by .81 equals 60 twist gear. Twist calculation of warp slubbers: The square root of .60 equals .775x1 equals nearly .78 turn per inch. 48.17 divided by .78 equals 62 twist gear.

We next calculate the draft of the intermediates: .65 (2 into 1) equals .325; 2 divided by .325 equals 6.15 draft. Draft constant 236.88 divided by 6.15 equals 38 draft gear. We now find the draft of the warp intermediates: .60 (2 into 1) equals .30; 1.65 divided by .30 equals 5.5 draft; 236.88 divided by 5.5 equals 43 draft gear. We next calculate the

TWIST PER INCH

for the filling intermediates. The square root of 2 equals 1.414x1.1 constant equals 1.56 turns per inch. Twist constant 57.90 divided by 1.56 equals 37 twist gear. We next find the twist per inch and twist for the warp intermediates. The square root of 1.65 equals 1.284x1.1 equals 1.41 turns per inch. 57.90 divided by 1.41 equals 41 twist gear. We next calculate the draft of the fine speeders. 1.60 (2 into 1) equals .80; 4.5 divided by .80 equals 5.62 draft.

An allowance of 1 per cent should be made here, and 1.5 per cent on the jacks. The contraction is so slight on the slubber and intermediates, that it is seldom if ever taken into consideration. However, we will give the following example so that the reader can see at a glance how the contraction is found. Draft of frame 7.09, hank roving fed in 1.86 (2 into 1) equals .93 hank roving turned off 6.45 hank. 7.09x.93 equals 6.59; 6.45 divided by 6.59 equals .97; 100 minus .97 equals 1.03 or 3 per cent contraction. So we multiply 5.62x1.01 equals 5.67 draft. Draft constant 236.88 divided by 5.67 equals 42 draft gear.

We now find the draft that should be on the jack frames: 2 (2 into 1) equals 1; 6.5 divided by 1 equals 6.5 draft; 1.5 per cent allowed for contraction; 6.5x1.015 equals 6.5975 or 6.60 draft. Draft constant 312 divided by 6.60 equals 47. We next calculate the twist per inch on the fine speeders. The square root of 4.5 equals 2.121x1.2 equals 2.55 turns per inch. Twist constant 113.87 divided by 2.55 equals 44.6 or 45 twist gear. We next find the twist per inch and twist gear for the jack frames: The square root of 6.5 equals 2.54x1.2 equals 3.05 turns per inch; 113.87 divided by 3.05 equals 37 twist gear.

We give the following table which will be found very accurate in calculating the required

COILS TO THE INCH

on the bobbin for any given hank roving. 1 hank or below 7½x square root of hank; 1 hank to 2 hanks 8½x square root of hank; 2 hanks to 3 hanks 9½x square root of hank; 3 hanks to 4 hanks 10x square root of hank; 4 hanks to 6 hanks 10.5x square root of hank; 6 hanks to 10 hanks 12.5x square root of hank.

Using the above table we calculate the coils that should be on the filling slubber bobbin to the inch: The square root of .65 equals .806x7.5 equals 6 coils to the inch. Lay constant 72 divided by 6 equals 12, lay gear. On the warp slubbers we have: The square root of .60 equals .775x7.5 equals 5.8 coils to the inch. 72 divided by 5.8 equals 12 lay gear. We next find the coils and lay gear on the filling intermediate. The square root of 2 equals 1.414x9.5 equals 13.43 coils to the inch. Lay constant 200.4 divided by 13.43 equals 15 lay gear. On the warp intermediate, the square root of 1.65 equals 1.284x8.5 equals 10.91 or 11 coils to the inch. 200.4 divided by 11 equals 18 lay gear. We next find the coils and lay gear on the fine and jack frames: The square root of 4.50 equals 2.121x10.5 equals 22.27 coils to the inch. Lay constant 350 divided by 22.27 equals 15 lay gear. On the jacks the square root of 6.5 equals

2.549x12.5 equals 31.86 coils to the inch. 350 divided by 31.86 equals 11 lay gear.

A slubber making .65 hank roving with a spindle speed of 630 revolutions per minute and a 1¼ inch diameter front roll making 165 revolutions per minute will turn off 10.92 hanks per day which is equal to 21.84 hanks on the two slubbers or 120 hanks per week; assuming we have 3 slubbers making filling roving the total production for the week would be as follows:

Total hanks 180. 72 divided by .65 equals 110.76

CONSTANT PRODUCTION.

110.76x180 equals 19,937 pounds of filling slubber roving. A slubber making .60 hank roving with a spindle speed of 630 revolutions per minute with 1¼ inch front roll making 173 revolutions per minute will turn off 11.17 hanks per day or 22 hanks on both frames, which is equal to about 121 hanks per week. Assuming we have 3 slubbers making warp slubber roving, and the total hanks 182, we have the following: 72 divided by .60 equals 120 constant production. 182x120 equals 21,840 plus 19,937 equals 41,777 total pounds. In the above method if the production should be found too great or too small, the difference to the intended production, should be divided by the production of one spindle and the quotient is the extra number of spindles, or the number of spindles required to balance the production.

We now find the number of intermediate spindles and also the number of frames. We employ another method to make it more clear. No. 96.

XCVII. PRODUCTION OF ROVING.

We are supposed from calculations already given to turn off 41,300 pounds 15,963 pounds intermediate roving. of 1.65 hank warp roving, and 2 hank filling roving. The first thing to do in this method is to average the two hanks, 2 plus 1.65 equals 3.65 divided by 2 equals 1.825, call it 1.82. An intermediate with a 1¼ inch diameter front roll making 162 revolutions per minute will turn off about 5½ pounds per day or 29 pounds per week (see catalogue), 41,300 divided by 29 gives 1,426 intermediate spindles required. We call it 1,428. The number of frames of filling 6, of warp 8, total 14. 1,428 divided by 14 equals 102 spindles to each intermediate. Hanks turned off filling intermediates 313; 102 divided by 2 equals 51 constant. 51x313 equals of warp and filling intermediate roving, Hanks turned off the warp intermediates, 420.102 divided by 1.65 equals 61.81 constant. 420x61.81 equals 25,960 plus 15,963 equals 41,923.

We next find the number of fine and jack frame spindles. Using the same method as finding the intermediate spindles, we have: Production required for the warp 26,500 pounds. A fine frame 7x3½ inches with a 1⅛ inch front making 128 revolutions of front roll per minute will turn off 1.85 pounds per day or 10.17 pounds per week of 56 hours. 26,500 divided by 10.17 equals 2,605

FINE SPEEDER SPINDLES

required. 2,605 divided by 14 equals 186, number of spindles to each fine frame.

Production required on the jacks 13,800 pounds. Referring to the catalogue we find that a jack frame 6x3 inches with a front roll speed of 120 revolutions per minute will turn off 1.21 pounds per day or 6.65 pounds per week of 56 hours. 13,800 divided by 6.65 equals 2,073 spindles required. 2,073 divided by 10 equals 207 or 208, number of spindles to each jack frame. Hanks turned off the fine speeders 644. 186 divided by 4.5 equals 41.83 constant production. 644x41.83 equals 26,616 pounds of warp roving.

Hanks turned off jack frames 433; 208 divided by 6.5 equals 32; 433x32 equals 13,856 pounds jack roving. Chart 1 shows the equipment and hang-up for a medium cotton mill. All calculations made in Chart 1 employed the above methods. The constants given to find the turn per inch, and the contraction of twist is taken into consideration. Chart 2 shows a coarse mill, the calculations given are taken

from the catalogue. This was done so the student could, by following our explanations, soon learn our short method in obtaining all calculations given. Chart 3 is a very fine goods mills. In this chart the contraction of twist is

TAKEN INTO CONSIDERATION,

but like Chart 2 the calculations are based on ordinary twist, 1.2x square root of hank, with an allowance of 15 minutes per set for doffing and stops.

It will be noticed that we give a great loss in our carding calculations; the reason for this is so that the card room will turn off just a little more than the spinning. Again, when using poor stock as was explained, more waste is made together with a loss of production. However, with such an arrangement and equipment as in Chart 1, 700 pounds should be the maximum amount of waste made in the card, spinning, and mule rooms using Middling upland cotton. The above charts give the young men working in a cotton mill every opportunity to quickly learn how to make all calculations. It will be noticed also that the production is greater at one process. This was explained elsewhere, as was the matter of making the warp and filling equal. The warp drawings in Chart 1 run at a slower speed than the filling drawings, the reason for this, is that it is a poor practice to put in only enough deliveries to just supply the intended production, because when the work is made lighter they must be driven much faster, or the sliver made heavier. With such an arrangement as given in Chart 1 the sliver can be reduced and the front made to revolve like the filling side and the same amount of production obtained. We will now give an outline showing how to make a weekly report, and also how to manage a card room. No. 97.

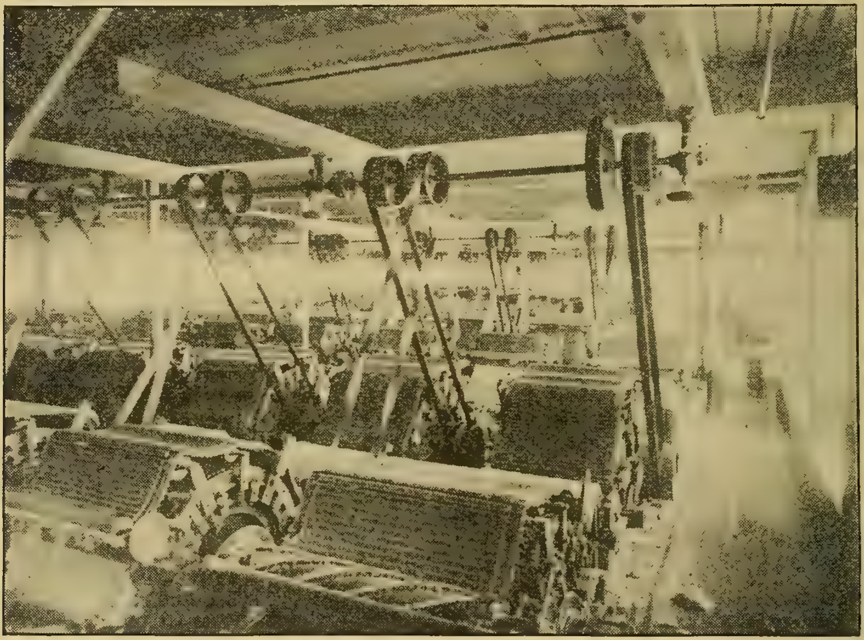


Fig. 34A. Card Room in a Medium Mill.

(Note the manner in which one of the belts has been temporarily shortened for grinding the wire.)

XCVIII. CARDING COST.

The science of exact carding cost means simply good bookkeeping and an itemized report in order to have the proper knowledge of how much or little gain is made for a certain hank roving. It is safe to assert that there is no business of the world where there is so much guesswork as there is in a cotton mill. Some mills have no accurate system of cost finding at all.

Such conditions should not exist in a cotton mill, but it is with regret that it must be said that it does exist in many mills at the present time. The following is the system carried out in many mills when changing hank roving to make a certain weight cloth. The superintendent will go to the carder and say: "What will it cost to make a five-hank roving?" The carder begins to figure it out in his own mind, he does not want to be dishonest, but he has, like most men, a certain amount of pride and wants to do his work at as low a cost as the carder in a neighboring mill making the same hank roving, so he gives the superintendent his cost, based probably on a week's run under the most favorable conditions. Arrangements are made to run the roving, and the cloth sold below the cost of making the roving. The carding cost or the cost of other departments should not be figured from

A WEEK'S RUN

or production, but from the exact cost taken from the report similar to the report given below, apportioning each item of labor and material among the different processes. In this way the superintendent has a copy of the reports of each department and in this way knows whether the cost increases or decreases from week to week. Should there be a marked increase in cost he should ascertain why.

Again if the hank roving is changed and the amount of hanks required figured from the difference in the twist gear and the price per hank also considered, the difference in the cost can be quickly figured and for a long period. If the report given below be examined, it can be seen that the average cost for any item for three to six months can quickly be ascertained. The carding cost as a rule, is given very little consideration by most mill men, especially by men who have charge of a plant and have had no experience in a card room.

No experienced millman can deny that the difference in the grade of cotton will sometimes make a difference of 4 per cent in the total production. Atmospheric conditions will make as much variation and when these two extremes exist together, the production suffers to an alarming extent. When there is a falling off of the total production, the total cost is made much higher, owing to the amount of money paid to the day help being the same each week. Some carders will

MAKE MATTERS BALANCE

at times, which is easily done if the superintendent is unable to size the roving and at the same time know how to find the production on all fly frames. Below we give a weekly carding report for the benefit of young men who are anxious to get such methods, and for the millmen in general.

It will show the beginner how to find every item and cost for same, it will show the manufacturer that the carder must be honest if he is obliged to produce the number of hanks every week end.

In making out the weekly report for the convenience of calculations we will use Chart No. 1. The hanks, of course, can be taken either daily or weekly, but more production can be obtained by taking the hanks daily, because women have also a certain amount of pride, and if the work turned off is placed before their eyes every day, all energy on the part of the tenders will be put forth in order that she or he may head the hank board. However, we will assume that the hanks are taken on the slubbers, intermediates, and fine speeders, and the amount of hanks turned off is the same as given in Chart No. 1. On the filling slubber, we have 180 hanks. 180x110.76 equals 19,937 pounds.

Price per hank $.10x180 equals $18. 72 spindles to a frame, 3 frames x72 equals 216. Hank roving .65. If the reader will now

REFER TO CHART

No. 1 and to the report it should be seen that finding the total amount of pounds filling intermediate, 102x6 equals 612 pindles. Price per hank $.10x313 equals $31.30. We next find the production and cost of the warp side. 420x61.81 equals 25,960 pounds warp intermediate. 102x8 equals 896, price per hank $.0825x420 equals $34.64 cost. No. 98.

CHART NO. 1.—REPORT OF CARDING DEPARTMENT.

Week ending ———— 191

Number of days run.

Total pay roll..............................$397.49
Total cost per pound...................... $.0097
Number of day hands.

	Warp.									Weft.							
	No. of frames.	No. of spindles.	Total No. spindles.	Constant.	Hanks turned off.	Cost.	Hank.	Production.		No. of frames.	No. of spindles.	Total No. spindles.	Constant.	Hanks turned off.	Cost.	Hank.	Production.
Slubber	8	72	216	120	182	$16.51	.60	21,840	Slubber	3	72	216	110.76	180	$18.00	.65	19,937
Intermediate	8	102	896	61.81	420	34.65	1.65	25,960	Intermediate	6	102	612	51	313	31.30	2.00	15,963
Fine	14	186	2,604	41.83	644	64.40	4.50	26,938	Jack	10	208	2.080	32	433	47.63	6.50	13,856

Production, warp roving, 26,938; pay roll, $115.56; cost per pound, $.0043. Production, jack roving, 13,856; pay roll, $96.93; cost per pound, $.0070; total production, 40,794; average cost per pound, $.0052. Pay roll, day help, $185; total cost of hanks, $212.49; average cost day help, $.0045.

OVERSEER.

production and the cost with a chart is very little trouble. Such a chart is also valuable to carders having charge of more than one mill in a large plant. We next find the production on the warp. Refering again to the chart we find a different constant production, because on the filling we are making .65 roving and on the warp side .60 roving, and as we must divide hank roving into the amount of spindles on the frame, the constant for the filling slubber is 110.76 and for the warp 120. Hanks turned off 182x120 equals 21,840 pounds of slubber roving. The amount of spindles will be the same, 3x72 equals 216. Price per hank $.0907. 182x$.0907 equals $16.51 cost. Now it is not necessary to take up any more space in explaining the method of finding the production so we will figure each process and afterwards explain how to find the cost, etc. In using the above method the carder should have a list of constants, so that it will not be necessary to find the constant every week. We next figure the production of the filling intermediate. 313x51 equals 15,963

XCIX. FINE SPEEDER COSTS.

We next find the production and cost of the fine speeders. 41.83x644 equals 26,938 pounds of fine roving. 186x14 equals 2,604 total number of spindles. Price per hank $.10x644 equals $64.40 cost. We next find the production of the jack frame. 32x433 equals 13,856 pounds of jack roving. 208x10 equals 2,080 total spindles. Price per hank, $.11x433 equals $47.63 cost. We next add the cost of the slubber, intermediate and fine speeders together and divide by the production of the fine speeders and this gives us the cost of the fine roving without the day help. $115.56 divided by 26,938 equals $.0043 nearly or almost one-half cent to the pound. We next find the cost of the filling side. $96.93 divided by 13,856 equals $.0070 nearly or almost three-quarters of a cent a pound. We will assume the day help cost to be $185, which is about the cost for day help to handle the above amount of production. The total production is 40,794 pounds of finished roving. We next find the average hank which is obtained by dividing the total num-

ber of hanks into the total production and the quotient found divided into the average number of spindles. Total hanks turned off 1,077. Average number of spindles 195. Total production 40,794 divided by 1,077 equals 37.88 which is the average number of pounds to each hank turned off in the room, 195 divided by 37.88 equals 5.15 average hank. Total cost for all hanks $212.49. $185 plus $212.49 equals $397.49 total cost.

$397.49 divided by 40,794 equals $.0097 or almost one.

CENT TO THE POUND

for making a 5.15 hank roving. We next find the average cost per pound or the roving. $212.49 divided by 40,794 equals $.0052.

We next find the average cost per pound of the day help. $185 divided by 40,794 equals $.0045 or $.0052 plus $.0045 equals $.0097 for the day help and roving together as in the first case. Now suppose the superintendent should ask how much more per pound would it cost the room if all the jack frames were changed to 10 hank roving. We refer back to the catalogue and we find that we must insert about 3.79 turns to the inch of twist in a 10 hank roving. We find also that the 6.50 hank will turn off only 6.56 hanks—a difference of 1.31 hanks. 1.31 hanks per day on one frame is equal to 72 hanks per week on ten frames. Referring to the chart we subtract 72 hanks from 433 and we have 361 hanks that can be turned off when making 10 hank roving. We next find the price per hank in the same proportion as the twist gear. Refering to the chart we get the twist constant which is 113.87 divided by 3.79 equals 30 twist gear for 10 hank roving. We have on a 37 twist gear, 37x.11 divided by 30 equals $.1356 price per hank. 361x$.1356 equals $48.95 cost of making 10 hank roving. 208 divided by 10 equals 20.8 constant for production. 20.8x361 equals 7,508 pounds of 10 hank roving.

We next find the cost of the intermediate hank roving to make 10 hank roving without having an excessive draft. So we divide the draft which in this case is 6.60 (see chart) 10. divided by 6.60 equals 1.51 hank two into one. 1.51x2 equals 3.02 Intermediate hank roving that must be produced for a 10 hank roving. We refer again to Chart 1 and we find we are inserting 1.56 turns to the inch.

We refer back to the catalogue and we find that we must insert about 2.08 turns to the inch into a 3.02 hank roving. Using the same method as on the jack frame, we have: 10.42 hanks per day less 9.15 equals 1.27 hanks. 1.27 hanks on one frame is equal to 42 hanks per week. 313 minus 42 equals 271 hanks that can be turned off the filling intermediate making 3.02 hank roving. We next find the price per hank. 57.90 divided by 2.08 equals 28 twist gear for 3.02 hank. We have now on 37 twist gear. 57.90 divided by 2.08 equals 28 twist gear for a 3.02 hank roving. 37x$.10 divided by 28 equals $.1321x271 equals $35.80 cost of making 3.02 hank roving. 102 divided by 3.02 equals 33.77 constant for production. 33.77x271 equals 9,152 pounds of filling intermediate roving. We next find the cost of the slubber roving to make 3.02 intermediate roving. Referring again to Chart 1, 3.02 divided by 6.15 equals .49x2 equals .98 hank slubber roving to make 3.02 intermediate roving. Twist per inch inserted in .65 hank .81. Twist per inch that must be inserted in .98 hank, about 1 turn. 10.92 hanks turned when running .65 hank, 10.18 when running .98 hank a difference of .74 hank or 12 per week. 180 minus 12 equals 168 hanks that can be turned

OFF THE SLUBBER

when making .98 hank roving. 48.17 divided by 1 equals 48 twist gear. 60x$.10 divided by 48 equals $.125x168 hanks equal $21 cost. 72 divided by .98 equals 73 constant for production. 73x168 equals 12,264 pounds of slubber roving. No. 99.

C. FILLING ROVING COST.

We now find the total cost of the filling roving which is $21 plus $35.80 plus $48.95 equals $105.75 $105.75 plus $115.56 equals $221.31 plus $185 equals $406.31 total cost of pay roll. 26,938

plus 7,508 equals 34,546 total production. $406.31 divided by 34,546 equals $.0117 cost per pound.

It can be seen that the actual cost can be found in a very short time by the above method, and the carder can do what he says, regarding the cost, because he knows that the above is not guess work.

The above report is valuable to the superintendent, because if a carder should allow too many hanks, his actual production can be found by multiplying the number of hanks on the pay roll by the constant. Again, if he should put down the proper production and pay for too many hanks, by dividing the constant into the production the number of hanks given away can be found.

Some carders have a practice of reporting the hank roving much lighter than it really is. For instance, in Chart 1, the warp intermediate production is 25,960 of 1.65 hank roving. We will now give an example of how a superintendent can be lead astray regarding the cost if he neglects sizing the roving and yarn often. We will assume that

THE ACTUAL HANK

intermediate warp roving in Chart 1 is 1.40 instead of 1.65. 102 divided by 1.40 equals 72.85x420 equals 30,597 production. 30,597 divided by 61.81 equals 495 minus 480 equals 15 hanks that can be given away and still balance the production. It can be seen that with the above chart such a practice can not exist if the superintendent will size the roving and yarn.

In some mills the price per hank is very low and the carder allows so many hanks when making up his payroll. This is a very bad practice. It is impossible to do this and at the same time require the carder to have a hank-board in his room. The only proper way is to fix the price per hank so as to give the same wages as when hanks are allowed. Then have a hank-board hung in a prominent place, and upon it post the clock readings every Monday morning.

The hanks should be recorded daily and the figures placed on the board so that the speeder tender that has the lowest number of hanks can see where she stands. It will be found in most cases that speeder tenders want to head the hank board. The bad roving should be recorded beside the hanks, so that if a speeder tender in trying to head the board should let much bad work reach the spinning room, she will

GET NO CREDIT.

Carders often ask, "How much bad roving should a speeder tender be allowed to make?" The answer is, "None". There is no excuse for making double and single. No. 100.

CI. CARE OF MACHINERY.

The proper care of machinery is an important consideration in every department of a cotton mill. When an overseer enters his room each morning he should try to look upon all the machinery—representing thousands of dollars—with a feeling of responsibility. He should make sure that machinery intrusted to him is handled carefully and should realize that the life of the machinery is the life of the plant. Some writers advise keeping the machinery up to its highest productive capacity, pointing out that the maximum production of the machinery reduces the cost. This is one of the greatest mistakes made in most all cotton mills of America. Why do we get a stronger yarn from a stationary top card? It is not because it is a better card, we know differently, it is the difference in the speed. Again, why does the outline of the American cones differ from the English cones? The difference in speed is the cause. The rod attached to the hollow leg of the flyer has a tendency to follow a straight line of force, but is prevented from so doing by being attached to the hollow leg of the flyer. The faster the flyer, the more pressure on the first layers, then as the bobbin fills this

PRESSURE DECREASES.

as the presser finger changes its angle which brings the presser rod nearer the spindle and the pressure is reduced in

the same proportion to the change of the presser finger angle.

High speed on a fly frame will cause much more friction of the cone belt, owing to the vibration of the cones. Why are most all drawing frame steel rolls shamefully abused by the unskilled help? When a drawing front roll is made to revolve at a speed greater than 400 revolutions per minute, it only takes the fractional part of a minute from the time a trumpet chokes, and the frame fails to stop, for the cotton to become lapped around the steel rolls. Roller laps on all high speeded drawings are very

HARD TO REMOVE,

because the high rate of speed causes the frames to run for a longer period after the lap is formed than it would with a lower speed, consequently the roller lap is much harder, and, of course, more difficult to remove, sometimes the steel rolls are bent and the gears broken.

The manner in which the drawing frames are cared for in some mills, would make very discouraging reading for the stockholders. In some mills where the help is not cautioned against using knives, steel hooks, and even hammers and screw-drivers, the first thing done when a lap is formed is to cut it off with a knife. The writer has seen cases where a part of

THE FLUTES

was cut for an inch or two to such an extent that its drawing quality was destroyed. Again after the lap is cut it is sometimes difficult to remove it from between the rolls. In such cases the writer has seen drawing tenders and even second hands and overseers use a screw-driver and hammer. The lap wedged between the rolls was driven off the boss to the space between the roller stand and the boss of the rolls. The only proper way to remove a large roller lap that is badly wedged between the rolls, is to remove one steel roll. When an ordinary lap is found on any steel roll, the lap can be removed almost as fast with the two thumbs as with a knife, especially if the roller lap is on the front roll where the fingers of both hands can rest on the clearer cover and the two thumbs given an oscillating movement on the surface of the lap, this movement will quickly loosen the lap to such an extent that it can be moved very easily, try it. It is a shame that we can enter cotton mills which have been in operation only a few years and find the machinery showing marks of unnatural wear due to lax methods for which the overseer is to blame.

Machinery, will deteriorate in efficiency with proper care; therefore, if neglected its efficiency is more quickly reduced. A short time ago the writer visited a cotton mill and noticed a drawing tender

CUTTING A LAP

from the front roll of a drawing frame. Then before our eyes he took a broken file and a brick to drive the lap from between the bosses of the front and second roll. When the overseer's attention was called by the writer to the manner in which the lap was being removed, and he was asked if he allowed such a practice, he said "This machinery will last while I am here and then the fellow that takes charge can have a whack at this place and then he will realize what I was up against".

In any cotton mill where the machinery is properly cared for, plenty of good help will be found, with the production turned off good in quality and quantity. Every person seems contented, and the man in charge respected. No man should neglect machinery, because it is old, but instead, should watch it more than the new, because when new machinery is well cleaned and oiled it needs very little watching. With old machinery even when properly cleaned and oiled, the different parts are more liable to get out of order. All overseers should train their help to take pride in doing their part in the proper care of machinery.

The overseer that can, through perseverance, train his help so that they will understand that the taking care of their machinery is a benefit to them-

selves, will always be contented and respected. When an overseer feels like the overseer quoted above, he himself is to blame. Think how much more that drawing frame tender

WOULD ESTIMATE

his overseer's character, if he had kindly taken the brick and file from him, and explained the harm to the machinery that such a practice will cause. He, too, would feel as if he lived a life that becomes a man, and not have the feeling that each working day is his last. When an overseer has a discontented feeling through his own neglect he fears for his job, and he is afraid of ordering any supplies, and the machinery and all concerned suffers. Many carders having such a feeling will in the winter months when the carding gains on the spinning rooms which necessitates the stopping of the surplus machines, rob the different parts from the temporarily idle machines, in order to keep down the supply expense. Any overseer of any department that will rob or allow the idle machinery to be robbed is an enemy to the concern for which he works, because mills have been known to cancel large orders on account of not having the necessary machines in readiness. No.101.

CII. CARD-ROOM MANAGEMENT.

In the management of a card-room, the carder's aim should be: 1. To produce good work, with as large a production as is consistent with the quality of the work required; to avoid unnecessary waste, keeping down the expenses of wages and power, and keeping the machinery in good condition. 2. An overseer must study and make himself thoroughly acquainted with the different tempers and dispositions of help under his charge, and adapt his conduct and proceedings accordingly. Keep cool and good tempered, and so conduct yourself towards your help as to gain their respect and esteem, and no matter what happens be already to give instructions to those who are in need of them instead of running with questions to the superintendent who always has enough trouble of his own. An overseer should never complain no matter what happens. He should be

EVER READY

to grasp the situation and protect his company's interest, and exercise justice toward all concerned, and keep everybody busy instead of trying to do all the work himself. Managing help in any room of any cotton mill is a very important factor in the successful operations of tue room and also the plant. An overseer should be a good judge of human nature so that he can employ good, moral people that will work and do all in their power for the good of themselves and the room. If only a picker hand is being employed, the importance of filling the automatic boxes evenly at all times should be explained. The evener motion should also be explained, and it should be shown to the new operator that, when laps are allowed to run out, such a practice is quickly discovered in the card-room. If a grinder is being employed, question him about his ability as a grinder, ask him about his methods of setting and at what distance he sets the different parts. The stripper when employed should be questioned about letting laps run out, he should be told that letting a lap run out in this room means immediate discharge, owing to such carelessness doing so much damage to the different parts of the card. If a person is employed for the sliver lap, ribbon lap, comber and drawing frames, the proper method of piecing should be outlined. He should be cautioned about the ends put up at the back just

SLIGHTLY OVER-LAPPING

the end running out. If persons are employed for fly frames they too should be questioned, and not put in charge of a pair of frames just because they say they can run a pair.

They should be questioned regarding the cleanliness of the work, they should be asked what parts should be kept clean and so forth.

Of course, there are times when a hand could not well explain herself and still be a good speeder tender. The object in questioning a hand in that respect is to learn from the person whether they understand the importance of keeping the top rolls clean, keeping the hollow leg of the flyer clean, the rack, and all gears governing the excess speed.

Some carders may think that the above method is a long one in employing help, but let me say, that it is often one or two hours after starting before the writer has all hands in place, owing to the amount of questions demanded from the employe, besides explaining to them the manner in which their duty should be performed. This little trouble at the start has convinced me of this, that people employed under such conditions will stay with you and not be always changing from one mill to another.

Where you find a steady class of help in a mill, which is one of the chief points in the success of the room or plant, you find good production and good quality also. There is one point in managing help that will cause the loss of influence, and that is, in yielding a point to a hand because that hand is of a family of influence, or connected with a large famil of help. Have your

DISCIPLINE

carried out to the letter in the room of which you have charge, no matter at what cost. Do not place too much confidence in your second hand, as sometimes good help are forced to quit their jobs for no other reason than the second hand imposing on them by not keeping their machines in good order, such as changing rack gears, twist gears, and some of the many other gears found on fly frames.

All good observant overseers of carding will, after placing the help, make their rounds, first to the picker room to see if the automatic feeders are being filled evenly. The small lattice apron should also be examined. If the beaters are making too much noise, the machine should be stopped and the beater examined, because beaters when dull make a noise caused by the vibration due to the blade of the beater being dull and not chopping off the cotton at each blow as it should. The evener belts should be examined and also the record of lap-weights. Weigh a couple of laps yourself, but at a different time each day. A carder should walk up and down each card alley, and while passing the back of the cards, the flats should be examined to see if the wire on the flats are injured from a high place in the cylinder, caused by the card-fillet blistering, etc. When passing each card the web should be examined by taking a portion of the web from the card and if not satisfactory, the carder should be able to place the blame in the proper place for such conditions. Sometimes the web on a card is very deceiving. For instance, if a comb band breaks and is not detected by any one, the card will fill to such an extent that the card will stop, owing to the consumption of power required being too great for the driving belt. In the majority of cases like the above, a couple of strippers and grinders will put all their power to the driving pulleys, and with the aid of the drawing belt and new comb-band that operates the comb, the cylinder and doffer is made to revolve and the amount of cotton on the cylinder and doffer partly removed by the doffer comb. No. 102.

CIII. CARDERS' TROUBLES.

When a card becomes in such a condition that it stops with the belt on the tight pulley, it should be seen that the cotton is accumulated between the wire of the cylinder, flats and doffer and is forced to the foundation of the fillet. If the card is started again without stripping, the millions of neps will find their way to the top of the wire point and thus to the sliver.

The above practice is the cause of making so much second quality

cloth in the majority of our cotton mills. Such neps appear like snowflakes on the surface of the cloth which gives the latter a bad appearance, and in most cases makes it unmerchantable for the goods it was intended. Let it be our aim to properly strip cards which have for any reason become clogged with stock. This will remove all the neps and broken fibres from the cylinder and doffer fillet. The comb-boxes should be examined to see that they are not overfilled with oil. When comb-boxes are overfilled with oil, the end of the comb and also doffer end on the same side of the card as the comb is saturated with oil, which is caused by the vibration of the comb in the cut-out for its reception in the comb-box. While passing the card being ground, stop and listen, and if the contact of the emery wheel can be heard this indicates that the grinding is done too heavily. In winter time the combing of the doffer comb should be watched, to see if a part of the web has a tendency to follow the doffer. This is done sometimes by a heavy piece of lap running through; however, when such a thing happens the overseer should ascertain whether it is a heavy piece of lap or if the comb blade is uneven. This has been explained elsewhere, and the causes of an uneven comb-blade given. Such heavy places coming through is one chief objection to the use of a heavy lap, because it is obvious that if a bunch or tuft of cotton, when running a light lap, will cause

THIS HEAVY PART

of the lap to follow the doffer, the evil is increased by the use of a heavy lap.

A heavy lap will cause much sagging of the web on a muggy day, and if the card is of the 45-inch width type, the web will sag to such an extent as to return one-half the production back to the picker room as waste. All cylinder-boxes should be examined once every week to see that they are well filled with tallow. The overseer, after he is sure that the work produced from each card is satisfactory, will now turn his attention to the grinding and see that it is done regularly. Every overseer should have a record of every card ground, also when the flats are ground, and when the flats are cleaned to see that every card has the same treatment. Pull down the chamber door underneath the doffer to see if this fly is removed as it should be.

On the combers watch the top combs and see that they do no pounding, for reasons previously explained, also see that the machines are cleaned, and examine all top rolls to see if they are in good condition, on all machines. Watch every web on the drawing frames, to see if any are cutting or not having the proper number of doublings. While passing the fly frames if a spindle is found to be idle, the tender should be questioned about it, and see that it is again operated as soon as possible.

If roving is removed from the spindles here and there about the room, this indicates that the tension is out of order, and an explanation should be demanded from the tender for allowing a speeder to get in such a condition. Then she will either admit that she neglected calling the second-hand or that the second-hand neglected changing the rack. Any second-hand or section-hand that neglects changing the rack gear when conditions demand it should be immediately discharged. No. 103.

CIV. CARDERS' MISTAKES.

It is wrong for any carder to demand that no speeder tender shall touch the racks in any way, and at the same time have a man in his employ that refuses to change the rack gears. From what has been said it should be seen that there is no other neglect in a cotton mill that will cause as much bad work throughout the mill as neglecting changing the rack gear when conditions demand it.

When the sizing is done, it should always be performed at the same time, because if you should size your draw-

ing frames to-day at 8 o'clock in the morning and 2 o'clock in the afternoon, and tomorrow at 10 o'clock n the morning and 4 in the afternoon, the changes made from the sizings found may be in the wrong direction.

For instance, suppose we size our drawing frames to-day at 2 o'clock; the cards at that time are generally stripped, and there is no danger of any light work coming through. On the other hand if the sizing is neglected until 4 o'clock, some of the light work may be sized and

CHANGES MADE

on the heavy side when it should not be disturbed. We have given the variation in the card sliver before and after stripping, and from what we have just pointed out, it should be seen that the sizing of the drawings should be done at the same time daily. A great deal has been said and written about straining the roving when sizing, the claim being made that if the bobbins are too great a distance from the bite of the reel, the pull required to unwind the coils combined with the distance makes it test lighter than it really is. There is, no doubt, a great deal of truth in the above claim, but if the same method is employed when sizing the roving every day, it should be seen that when the work is once regulated to this method of sizing, the amount of straining, being always the same, will not affect the work.

However, the distance from the bite of the reel to the top of the bobbins should not exceed 36 inches. Again, when sizing it should be noticed, as when sizing drawing from full or nearly empty cans, whether the coils are from the top or the middle of the bobbin. The bobbins should be reeled when the coils are about 1½ inches from the top of the bobbin, so that when a certain amount required is reeled from the bobbin the coils will be unwound 1½ inches upwards and 1½ inches downwards, thus equalizing the pull on all strands.

A good practice to determine whether the proper amount of twist is inserted in the roving being sized (fine roving), is to reel the roving still more until the coils being unwound are nearly at the bottom of the bobbins, and if the strand on one or two bobbins should break before the coils being unwound are half way on the layer, this indicates that the cotton is coming in poorer and more twist should be inserted. On the other hand, if the roving being unwound carries from the top of the bobbin to the bottom without breaking and no hard ends are found on the intermediates it indicates that the proper amount of twist is being inserted.

When a new mark appears in the mixing-room, one bale should be run through as a runner as it is termed, and the changing that this necessitates in the arranging of the drafts and twist per inch, the weather conditions remaining the same, gives the carder a good idea how to arrange his gearing for the remaining bales of such a mark.

The floor should be

KEPT AS CLEAN

as possible and free from waste and bobbins.

Every oil bottle should be watched, and the belts cleaned and belt dressing added every week. Belt dressing should be applied to the belts when the speed is run slowly, so as to preclude the possibility of the belt slipping off.

All fire apparatus should be given its share of attention. Water pails should be filled and kept in their proper place. The fire blankets and hose-pipes ought always to be in readiness and the help instructed from time to time how to use them. The overseer and second-hand should know where the sprinkler inlet valve is situated and also the outlet. This is important, because in many ways a sprinkler head may accidently be opened. When a sprinkler head comes off over the cards and the flats receive a wetting,

do not stop the card, but instead, apply whitening freely on every flat. Then pull the stripping plate cover down; care should be taken, however, that no member is brought too close to the cylinder, when whitening can be applied freely here also. When fire occurs on a fly frame, the first thing to do is to have a couple of pails of water with hand brushes. With these water can be passed over all the skew gears, bobbins and spindle gears. The belt should be quickly removed, and then water applied freely at the head, while other hands should wipe up the water. Oil should then be applied where water is found. Every spindle should be lifted and allowed to drop at a height of 2 inches in order to force the water from the steps of the spindles.

A good method of keeping the bobbin gears clean is to have a system of cleaning one slubber, two intermediate, and four fine or

JACK FRAMES

every week. Scouring should be done once a year on the fly frames when all spindles should be pulled out and the bolster scraped. When the bolsters are scraped, a piece of cloth obtained from the cloth-room, that will reach the length of the frame, should be placed over the steps so as to avoid the possibility of any dirt dropping into the steps.

Requisites for overseers: Be promptly on hand at your work in the morning. Do not be afraid to get there ahead of time, and never be late. Put all your time into your job and give your employer the best that is in you. Do not watch the clock. Get off more work than expected of you if you possibly can. The man that grows fast in these qualities is soon found to be too big for the position he holds, and promotion follows. Every man must try to be larger than his position, but he must be mighty careful not to feel above his position, because he is then standing on dangerous ground. Make your position the apple of your eye and cling to it as though the whole world would grasp it from you if it could.

No. 104.

CV. RING SPINNING.

Ring spinning is a continuation of reducing the sliver from roving to yarn, and like the fly frame processes, as the roving is reduced to yarn twist is inserted, which is the chief point of difference. The effects of these two processes on the sliver is not only in the amount of twist inserted, but the method employed to insert the twist in each of these two processes differs to a very large extent.

The reason for this is that, in the fly frames, only sufficient twist is inserted into the sliver to enable the fibres to hold together so that the pull necessary to unwind itself from the bobbin will not separate themselves, which causes what is termed "breaking back". In the ring spinning frame when the sliver has passed the action of the drawing rolls, the process of attenuation is at an end, as the sliver has been reduced to the size intended. Here is where the amount of twist must differ, because instead of

INSERTING THE TWIST

in the sliver to unwind itself at the next process, it is necessary to insert sufficient twist to enable the sliver to withstand the processes of spooling, warping, slashing, and weaving. There are four kinds of spinning machines, but only two kinds are used to a great extent in the American cotton mills; namely, the ring frame, and the cotton self-acting mule. As known by most mill men, the ring frame differs considerably from the mule. The process of attenuation is the same, but the method in which the twist is inserted and the manner of winding the yarn differs to a large extent.

The difference may be termed as one machine spinning continuously, which is the ring frame, while the mule spins intermittently. The objects of the ring frame are the same

as the fly frame, only on the ring frame a different method is employed to insert the twist, which is accomplished by a string or band connecting the surface velocity of the cylinder to the whorl of the spindle. While on the fly frames this is accomplished by connecting gears as was explained. It must be understood also that the

RING FRAME DIFFERS

from the fly frames in winding the material on the bobbin. The passage of the strand from the drawing rolls to the bobbin of the fly frames has already been explained. The passage of the yarn on the ring frame is from the drawing rolls through a guide wire, which will be explained later, then through a device known as a ring traveler which it drags around the ring at a very high rate of speed. As stated, the mule being an intermittent spinning machine, a different form of winding the yarn, which differs from the fly frame and ring frame, is found in the mule. While the mule is performing the process of attenuation and twisting, no winding takes place for a few seconds, the next few seconds of time being occupied in winding onto the spindles the yarn that has been spun.

There is also a difference in the form in which the yarn is produced, the fly frame bobbin and the warp ring frame bobbin being the only two resembling one another in construction, as they are tapered at each end of the bobbin and to about the same degree, the chief difference being in the size of the bobbin, the warp ring spun bobbin being, of course, much smaller. When the yarn is wound off the bobbin with a filling-wind motion, instead of each layer extending from one end of the bobbin to the other, as on the warp wind, the layers extend only a short distance, usually the length of the cone shaped lower part of the bobbin, and each succeeding layer is moved slightly higher at end change of the traverse. The fly frame, and ring frame wind the yarn on a wooden or paper bobbin, while the mule winds the yarn in the form of a cop, using for a central support a paper tube of any length desired. The mule can build up yarn on the bare spindle firmly enough to be safely handled, but the use of paper tubes is a great benefit, because, as stated, they give the cop a central support which prevents the cop from breaking, thus saving waste, besides the finishing coils are not so liable to run from the shuttle in bunches.

No. 105.

CVI. FRAMES AND MULES.

Although ring spinning and mule spinning differ to a large extent in twisting and winding on the finished thread, many things can be said in favor of both methods. As regards the spinning frame, it may be said that it occupies less space than a mule, that a larger production is obtained per spindle, and it can be operated by men, women and children, while the mule is operated only by men. A spinning frame spindle will produce about 8 per cent more production than a mule spindle, the cost varying from 40 to 80 per cent, though the difference is not as great for fine yarns. As regards mule spinning, the consumption of power on a mule is about 150 spindles to one-horse power, against 70 for a spinning frame.

The chief item in favor of the mule is that a much softer thread can be spun, which gives the face of the cloth a better appearance, besides the feel is not as harsh as that of a cloth made from ring filling yarn. It has already been shown that the fibres when leaving the card are in a tangled condition, and the drafts in after processes exercised upon them gradually lay them in a more parallel order. The fibres which possess the greatest length are brought earlier within the range of the drawing rolls, and they also remain under their influence for a longer period than

THE SHORT FIBRES.

Thsi has been the well-founded and almost universally accepted theory

for many years. So the long fibres consequently are laid longitudinally in the yarn earlier than the fibres of a shorter length. Consequently, as has been proven many times, the short fibres tend to move towards the outside of the thread, and are in such a position that, when they are twisted around the longer fibres, the ends protrude from the sliver, which is termed nap by most mill men. From what has been said above, it does not need pointing out, that the extent to which this exists varies with the cotton employed. When a thread is ring spun this hairy or oozy appearance is lost, owing to the amount of twist that must be inserted in ring spun yarn to give the yarn the necessary strength to drag around the traveler; besides much of those short fibres are lost while passing through the traveler.

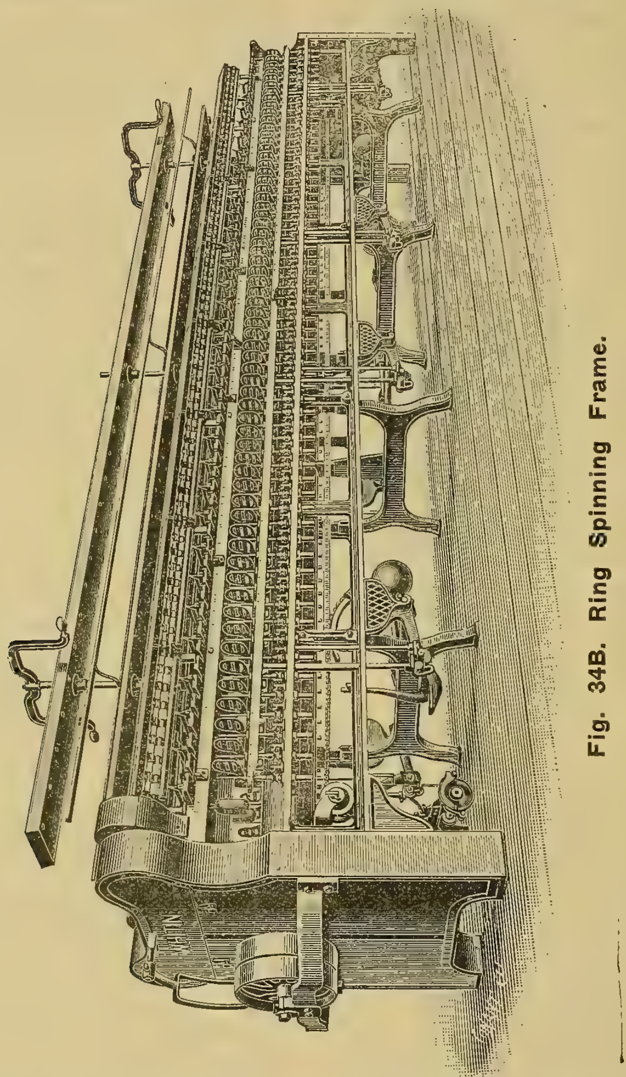


Fig. 34B. Ring Spinning Frame.

On the mule this hairy appearance is retained, because the thread is not called on to drag a traveler, the yarn

during winding being guided on to the spindles by the fallers. Ring frame yarn is used for many purposes, which requires a varying number of turns to the inch in the yarn. Warp yarn is largely governed in the usefulness of its application, the chief point to consider is its liability to break in the loom. Ring spinning is a task of enormous difficulty, and is one that may never be solved. The reason for the above statement is to make the reader think and study the object of spinning. As we see it, the object of spinning is to produce a perfectly cylindrical thread of equal diameter throughout its length, and at the same time, a thread containing at any point the same number of fibres in its cross section, a task, as stated, which seems impossible. No. 106.

CVII. QUALITY OF YARN.

The quality of yarn is more or less governed by the roving sent in from the card room. But it must be understood that there are many ways in which poor yarn can be made in the operation of spinning itself, and it is often the case that when trouble comes up the spinner places all the blame on the carder, when he himself is guilty. The strength of a warp should be based by the weakest thread in it, because it should be seen that one weak thread will run through the whole warp, and possibly break hundreds of times before the warp is woven out, and this trouble can be multiplied by the number of weak threads in the warp, and the production lessened correspondingly, besides making a poor quality of cloth that must be classed as seconds. The breakage of warp yarn has been watched and studied by the writer, and found to result largely from knots and bunches, rather than from weakness, as most mill men are led to believe. The cause of knots, poor piecings and bunches will be explained later.

Much has been said and written about the making of a perfect yarn. Most writers when writing on the subject will begin their article thus: "To make an even yarn", etc., and they go on and tell us how to make it; but it must be admitted that in our fine goods mills the utmost efforts are made to obtain an even sliver from the card to the spinning frame, although it is clear to any experienced mill man that these efforts can only be partially attained.

Examine the best-selected combed fibre with a powerful microscope, and it will be found that even combed stock is only a uniform staple in length and not one of diameter. If the above is true, the fibres of the best variety of cotton have different diameters, and if the sliver consists in its cross-section of cotton of a large diameter for a certain length and the next length cotton of a smaller diameter, it should be seen that even with the same preparation and the same number of fibres in its cross-section, a different diameter yarn can be produced.

Suppose that the lengths referred to above are six inches apart; the yarn will show light places as it passes to the bobbin, owing to the number of turns

INSERTED IN THE YARN.

stealing to the light places. The writer, after many tests, has come to the conclusion that even the best yarns, made in the most careful manner by combing and favorable conditions, with a large number of doublings, a certain amount of variation exists, which is found either by weighing several lengths or by microscopic measurement. The former method is, of course, the most convenient, but the different diameters existing in the different staple is not observed as in the latter method. Figure 34B is a view of a ring spinning frame.

There are two sides exactly alike, the ends from one-half of the bobbins being spun into yarn on one side of the frame, and at the same time, the other half are spun into yarn on the other side. The skewer on which the bobbin is mounted requires more care than most spinners think. The writer has in mind a case where the roving was continually

breaking back in the ring spinning room.

The plant consisted of two mills, and the breaking back was found only in one mill—both using the same grade of cotton. The carder, of course, was to blame, as usual, but the superintendent knew his business (which saved the carder his job), and having all twist constants, he ordered the carder to insert the same amount of twist as found in the other mill where the trouble existed. When the twist was figured out, it was discovered that the carder in the mill where the roving was breaking back had one tooth more twist, or, in other words, more turns to the inch than the roving that was not breaking back. An investigation was soon started, and the chief cause was found to be in having the guide rods too high, which caused too much of an angle when the coils on the lower part of the bobbin were unwound. The vertical position of the strand at this point made the pull too great, thus breaking the roving. The skewer bottoms were found bruised, which caused the creel step to offer enough resistance combined with the vertical position of the strand to cause the roving to break back. It was also found that instead of having the skewer tops even, or not quite as high as the surface of the top side of the board, the tops of the skewers projected on all the creels. The hoister being

RATHER CARELESS,

would often lay roving in such a manner as to touch the skewer tops, thus breaking back the roving.

All guide rods should be placed opposite the centre of the bobbin, so as to equalize the pull and reduce the angle when the top or bottom coils are unwound. Such conditions exist at this writing in many spinning rooms, and on a heavy running day, you will hear the overseer complain about the tricky carder having taken out the twist the day before, when at the same time, it is his arrangement that is causing the trouble.

A spinner should examine his roving guides every day and see that they are all in perfect order. Roving guides should be kept in constant movement, and never allowed to stop when the heart motion changes. This is an important point, and needs watching, because this heart motion often gets worn or loose, causing the rod to have a back lash. An example has already been given, showing the damage such a defect will cause, besides the expense for extra top roll covering. When

STARTING UP NEW

frames, the overseer in charge should satisfy himself that they are carefully leveled, and not trust to the men that are erecting the frames, because fitters will often erect a frame, so it will run only until they leave the room to go elsewhere. Machine companies are to blame in most cases for the above conditions, and instead of demanding a hurried job from their men, more men should be sent from the shop. For the first few weeks a new frame should be oiled every two hours, sometimes oftener, but wiping off the black oil every time new oil is applied. Before new frames are started the underside of the ring rail should be shellaced, as this will prevent lint collecting, which gives the room a bad appearance, because as this lint accumulates, the oil that is sprayed by the bands will also accumulate over this lint, and this makes it difficult to wipe off the lint, consequently when they are wiped a portion of the lint remains on the rail and they never appear properly cleaned. Adding a coat of the shellac requires very little labor and expense, and it does certainly improve the looks of the room.

No. 107.

CVIII. DEFECTS AND REMEDIES.

The breakage of ends on spinning frames is a fairly good standard of the conditions existing in any spinning room. With a fair quality of roving, all practical spinners agree, that there are plenty of chances for defects from the roving unwound in the spinning frame creel on the way to the spindle to cause such breakage. The top rolls may not be in good condition, or improperly spaced or weighted, and the flutes may be worn

almost to a knife edge, etc. All the above defects and their remedies have already been explained. The weighting of top rolls on spinning frames receives too little attention, which is the cause, to a large degree, for the great amount of weak yarn found in our cotton mills to-day. The general method of weighting the top rolls of a spinning frame is to apply the weight by a lever, a stirrup and a saddle. The lever should have three points or notches from where the weight is suspended, in order to get the full benefit of this method of weighting. Some, builders have allowed their new frames to leave the shop equipped with levers having only one point or notch where the weight is suspended. The method of finding the amount of pressure on the top rolls has been given elsewhere, and the reader should, when reading the following, refer back to that rule, and it will be clearly realized that moving the weight to a different point on the

LEVER AFFECTS

the pressure on the top rolls to a larger extent than it would be at first supposed. All practical ring spinners know that at times the cotton used in most print cloth mills varies in length and strength, and the quality of the yarn can be improved by giving the weighting of the top rolls the proper attention so as to give the latter enough drawing quality to draw the sliver under its action with the least amount of friction possible, and at the same time, not break the fibres. The chief aim of all good ring spinners should be not to carry useless weight on the top rolls, because, besides injuring the staple and the leather covering, the consumption of power is much greater. Out of 72 mills that the writer has visited, one spinner was found that knew the actual weight or pressure on the top rolls by the position of the weight on the lever, and he also knew the actual difference in pressure on the top rolls from one notch to another.. Our system of weighting top rolls is a very poor one, simply because we carry too much useless weight. What is wanted in our system of weighting is the removal of some of the weight found on the front rolls and add some of this weight to the back rolls. Builders should notice the above, and instead of having about five times more weight on the front roll than on the back, weight them all alike. Then, with a fair quality of roving,

SEVERAL TESTS

should be made, and it will be found that the writer has given you all something that will benefit the mill, rolls and material produced. Some spinners will tell us that they have very little faith in what the textile papers say on the subject of top roll weighting on ring frames. The reason for this is that many writers will tell us that when we are using wiry cotton the weight should be moved in the notch farthest away from the fulcrum point, and when the cotton is fluffy it should be moved to the notch nearest the fulcrum point. Some claim that this has been done and no difference observed. From the above we are forced to ask ourselves, Are our front top rolls properly weighted? Should there be a change in the method of weighting our top rolls for spinning frames? We have two saddles, why not have two stirrups so as to equalize the weight

The writer respects the above opinions because they are from men who have had much experience. They are known as men of good judgment, and when they tell us that moving the weight from one notch to another has little effect on the

TOP ROLLS,

it must be admitted that we are carrying useless weight on our front top rolls.

It must be understood that the same conditions do not exist in all mills, because in some, extra notches are cut on the levers, and the board between the weight and the levers is cut so as to enable the weight to be brought closer to the ful-

crum point, and thus reduce the pressure. Other mills have a heavy and light weight. The above is a good idea, because when a frame is changed from warp to filling, the pressure on the top rolls must be somewhat released, as only a pressure of about 6 to 8 pounds is found on ring frames when making filling, while a pressure of 20 to 26 pounds is found when making warp. But even with the above labor of cutting notches in the levers and in the board that suspends the weights when they are unweighted, or changing the weights, it must be said that through the faulty construction of having only one stirrup there are many instances where there is little or no pressure on the back rolls. This is due to the bulk of the weight being on the front rolls. No. 108.

CIX. WEIGHTING.

In the preceding article, we gave reasons why in some cases overseers find no difference in pressure of back rolls, even though weights are changed, or when moving the weight nearer to the fulcrum point, owing to having useless weight on the top rolls at all times. Of course, it must be admitted that the pressure is decreased when the weight is moved nearer to the fulcrum point and must help the front roll. But as there is always too much weight on the top rolls, the grip on the fibres is always too great, and no doubt many are broken, especially if the distance between the rolls does not exceed the average length of the staple. On the other hand, it can be seen from the above that when a lighter weight is used, or the weight moved to relieve the pressure, we then have trouble with our back rolls. If the reader is a spinner he must have experienced the above, because it is common to find many back rolls on ring frames that can be

EASILY CHECKED

only with the forefinger and thumb.

The reader should see that our system of weighting is wrong, and that the weighting should be more direct, as found in most all English mills. Again it must be admitted that we are pointing out a very bad and costly defect that takes place in our cotton mills every day when changing from filling to warp.

Weigh a weight suspended from a filling frame lever, and it will in most cases weigh less than a pound, while on the warp frame they generally weigh about 3½ pounds. This is pointed out simply to save the expense of roll covering that is found to be great when the pressure on the rolls is not varied when changing to fine work.

Fig. 35A. Double Adjustable Ring in Plate Holder.

It should be seen that a filling frame is weighted lighter because it always as a rule spins finer yarns, and the finer the yarn the better opportunity the flutes of the bottom steel roll have to cut into the top rolls, owing to the fine yarns having a smaller number of fibres in their cross section. This allows the bottom and top rolls to be in

CLOSER CONTACT

than when running coarse yarns. As we see it, there should be as much weight on the back rolls as on the front rolls, because the second drawing roll must hold the fibres so that the dual operation which always exists between the first and second rolls, namely, the front roll taking the

fibres from the second roll and the second roll holding the fibres from the front roll, should at all times be uniform.

If the amount of weight found, even on the most up-to-date American spinning frames, is divided among the three rolls, a better quality of yarn will be produced, and the roll bill reduced. The above is the cause for nine-tenths of fluted top leather rolls, or the useless and unnecessary wear of the front top roll covering. Many readers may claim that the wear is due to the front roll revolving at a much greater speed than the back rolls. But let me ask any experienced spinner which does the most work when the rolls are properly placed, and he will answer, the second roll. Very few mill men will agree to such a statement, but a little reasoning will convince the most skeptical that the wear is as great because the front roll is continually pulling the fibres away from the second roll; but owing to the pressure being less on the second roll than on the front roll, the fibres are pulled from the second roll in a larger number at one time than another, which is the cause of the uneven and weak yarn referred to above. If the second roll was made to carry the same amount as the front roll, that is to have about 9 pounds pressure on each top roll, it would be found, as stated above, that the yarn will be more uniform and much stronger. The above principal can be found on most metallic rolls in use at the present time, the heaviest weights being on the back rolls.

A matter that is often neglected by careless overseers, and from which bad work is sure to follow, is in not watching the levers to see that they are about horizontal. When levers are allowed to drop some, the wire ring will strike the creel board, thus relieving the necessary amount of pressure which makes the draft irregular and the production of an uneven thread is the result. No. 109.

CX. CARE OF ROLLS.

All spinners should have a system for oiling all rolls. One good method is to oil the back and middle top rolls on their middle bearings twice a week, and once a week on their end bearings. Use any ordinary oil can, and to check the oil from coming too freely, make a conical tube out of a heavy cotton cloth and insert a small piece of sponge in it. Then place this conical tube and sponge over the oil can tube. With the above device the oiler passes rapidly along the frames, exerting a little pressure on the sponge at each roll which is necessary in order to produce the oil, and when the can is quickly pulled away no dropping of oil takes place as with the old method.

If the above method is put into practice it will be found to prolong the life of the top rolls, especially if sperm oil is used. Top rolls should not be oiled with mineral oil, and if the reader will make a test he will find that mineral oil is a serious disadvantage. After the oiling is completed, or every morning, the front top rolls should be cleaned with a piece of hard or cop waste dipped in a mixture of equal parts of alcohol and water, this increases the drawing qualities of the front rolls three-fold. Top leather rolls for ring frames have two bosses, but of a different length for different kinds of work.

All top rolls should have tapered ends, and the cap bars milled to correspond, so that the waste, etc., can be removed without the use of a picker. It is almost impossible to keep ends of rolls clean when they are sunk down in the cap bars. Never allow spinners to use a hook or anything of metal of too hard a nature to clean any rolls. This prohibition will keep the rolls from getting scratched, especially the bottom steel rolls.

Many spinners prefer a long boss roll, but most of them are unable to give us the reason, and it is so misunderstood that we deem an explanational necessary here.

The short boss rolls are preferable that all roll coverers will tell you that it is impossible to cover two bosses of any length that will have a true outline throughout their length, so the shorter the roll the more even will be the surface obtained. From the above it can be seen that for coarse work the faulty outline of a long double boss roll does not affect the work to a large extent, owing to the bulk between the two rolls which enables the rolls to hold a grip at all times on the strand. However, for fine work they are a disadvantage, because this unevenness usually found on long double boss top rolls makes the draft irregular, thus making faulty yarn. It may be said also that this unevenness will cause many hard ends when the work is a little heavy or the stock in use a little longer than usual or wiry.

However, if such rolls are used for fine work, a good way to test the evenness of a double long boss roll is as follows: Place the roll on a perfectly plane surface, and roll it back and forth, and if any light can be observed the roll should be stopped at that point. If the roll is properly covered, very little if any light can be seen.

When a roll is found uneven, the faulty place should be gauged to the eye, and then tried, to see what effect such a place would have upon the strand, so that when the rolls are tested again and such places on the rolls are discovered they can be put aside at once and used in the two backs rows. As stated on coarse work, these defects will not amount to much, still a better roll is preferable. The long double boss roll acts upon two ends, while the short boss roll acts on one. Some mills have shell front top leather rolls. No. 110

CXI. SHELL ROLLS.

Shell rolls are fast passing their usefulness, owing to the same defects found as on the long double boss roll, but to a larger extent, owing to the bosses not being covered together on the arbor.

When the shell rolls are used, and are covered, they should be paired, and each pair covered on the same arbor, then they should be tied together. Solid rolls are much preferred, because they will produce a stronger and evener yarn.

There are many kinds of saddles, such as iron, rawhide and bronze, etc., but the cast iron saddles are used mostly and are without doubt the best. Saddles are provided with oil chambers, and the oil is conveyed to the roll bearing by means of holes that

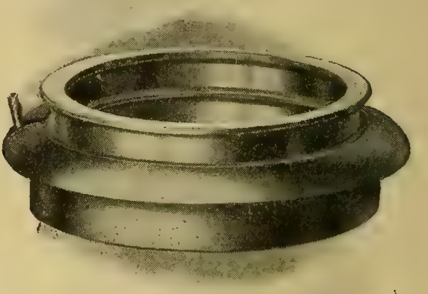


Fig. 35. Double Ring in Cast Iron Holder, With Concealed Traveller Clearer.

run from the oil chambers. Woolen yarn is drawn through these holes so that the oil chamber can hold the oil and deliver it to the roll as needed. The woolen yarn absorbs the oil, and delivers it in proper amounts as the roll revolves. The front saddle is made long enough to rest on the front roll and also on the raised surface on the back saddle that spans the middle and back rolls. The stirrup is supported by the saddles, and has a slot cut into its lower end for the reception of the lever. The nose of the lever is held to the roll beam by means of a screw that also has a slot for the reception of the lever nose. A weight is suspended on the lower end of a wire that has the form of a wire ring at its upper end and can be placed on the lever end or off the lever in an instant.

The stirrup passes between the front and second steel rolls and they should not be allowed to get out of place and rub on either side of the steel rolls.

One point about

WEIGHTING TOP ROLLS

is to ascertain, before leaving each weighted roll, that the parts from where the roll receive the pressure are not faulty in construction.

It is often found, as we have stated before, that through faulty construction of the saddles, stirrups, and levers, there are times when there is little or no weight on the back or middle rolls. Now let us reason together and study the principle of roll drawing. As we see it, all top rolls should revolve at all times as freely as possible. This is something that most all spinners know, but why not see that they do revolve freely at all times. Most overseers, accept conditions as they find them, and every day to them is a struggle. If all overseers would watch their neighbors and keep up with modern methods, they would, we dare say, appreciate the above explanations on roll weighting. We must visit other mills in order to see our own mistakes or improvements. It is only a week ago from this writing that the writer visited a mill, and noticed that the levers were cut so that only one notch nearest the fulcrum point could be used.

When I inquired why the levers were cut the spinner said that he had so many fluted top rolls of late, that no matter how often he moved the weights to relieve the pressure, it was only a short time before he would find half the weights back to the last notch on the end of the lever.

So he said he had the levers cut to protect the top rolls. When I put the question to him about what he would do when a wiry cotton would hit the room (thinking at the same time that I had my man nailed for making such a blunder), he quickly answered and said that the card room had an abundance of machinery, and that such cotton would be made of a lighter hank. So it can be seen from the above that this overseer is on his job and is a valuable man to any plant. Not forgetting that we are studying the principle of roll drawing, how must each part be constructed and arranged to draw the fibres from one another with the least resistance on the part of the fibres, and have the least possible friction on the top rolls, with the least possible frictional contact between the top front leather roll, and the bottom steel roll? No. 111.

CXII. SPINNING POINTERS.

All unnecessary friction must be removed from the bearings of the top rolls, so that the only resistance offered will be from the fibres under their action. To do this, the following points must be observed: 1. The top rolls must be kept clean, they must also be oiled as described, and kept free from any dirt which might tend to clog them. 2. The saddles must be watched to see that they do not get badly worn. We have given an illustration elsewhere, showing how a worn saddle affects the freedom of top rolls, causing excessive friction. 3. The stirrup must not touch either steel roll in any way, because the surface speed of the steel roll will in most cases (especially if the steel roll is not perfectly true) cause an oscillating movement on the saddles, which in time will wear the bearing of the saddles and the neck surface of the top roll uneven, and thus cause friction. 4. Care must be taken to keep the levers about horizontal, or they will be dropping down and relieving the rolls of the necessary amount of pressure, by the wire ring striking the creel-board. As a rule, all ring frames have excessive weight on the front roll. When the wire ring strikes

THE CREEL BOARD,

the pressure on the top rolls is somewhat relieved. This is true, to a greater extent on the middle and back rolls. From what we have said, it can be seen that the grip between the second top roll and second bottom steel roll is not as great; consequently the front roll will pull many fibres from under the second top roll

that it should have held, with the result that the yarn produced is much heavier. When the wire ring rests on the creel board completely, the yarn becomes extremely heavy and causes travellers to fly off, still most

Fig. 35C. Solid Single Flange Rings.

spinners will put on a new traveller and the wrong idea that the roving is uneven steals into his mind. Here is where the back roving should be sized, in order to ascertain the cause of the traveller flying off. If the roving is found of the required hank, the spinner knows then that there is a defect in his rolls. When the yarn is made heavy, the bobbin on which this heavy yarn is wound becomes filled sooner than the rest of the bobbins, and a dual operation takes place between the surface of the bobbin, traveller and ring. The yarn is made sc strong that it drags the traveller between the surface of the bobbin and the ring, even when the last coils wound on touch the ring. This causes the traveller to enter between the coils previously laid, thus injuring the yarn, and the bobbin is given a ragged appearance. Again, when the traveller is dragged around in the above manner, the smooth surface of the ring is scratched, which afterwards offers much resistance to the traveller. All good spinners that think and reason will tell you that the above defect is common in all spinning rooms, only they are not noticed.

5. If the first and second rolls are not set far enough apart over the length of staple being run, a constant friction will be caused on the front top leather roll, and if the yarn delivered be examined, it will be found to contain thick and thin places. 6. When the speed is increased, or when wiry cotton begins to come in, the space between the first and second rolls should be slightly increased; that is, if

THE TWO ROLLS

were properly spaced in the first place. It should be seen that when the speed is increased the front roll is not checked as easily, and instead of lagging behind, as it does when running slow, it will break some of the fibres which offer the most resistance. Wiry cotton must also have more space, because owing to the construction of the fibres which we have already explained, they are not so easily pulled from one another. At times, they offer so much resistance that the speed of the front roll is checked completely and the result is a hard end. To produce an even thread, the stock must be watched, and proper space allowed between the rolls. We dare say that opening and shutting rolls are unknown to many spinners.

They seem to think that as long as the staple is not increased in length, a quarter inch the rolls should not be disturbed. If the proper space is one-sixteenth of an inch over the length of the staple run, surely, if the length of the staple in the next mixing is one-eighth of an inch longer, the space should be increased. There are certain spinners who will tell you that the above is idle talk. Let us ask how it is that such spinners are complete failures and are always roaming around the country. There are, no doubt, many overseers who have had the chance to make good, but being unwilling to consider

the above details, they have failed to do so. No mill man can deny that what we point out here is true, and that such matters must receive attention in order to run a spinning room successfully. Again, no mill man can deny that many spinners know how to put the above into practice, but instead, they accept the conditions that the different kinds of cotton create, and they struggle along with them making every one connected suffer. There are two kinds of spinners, one class consists of men that keep up to date, and are themselves always making some kind of improvement, having the interest of the plant in mind at all times. The other kind are those that are troubled only by the speed of the clock instead of their machinery.

No. 112.

CXIII. DOUBLE ROVING.

Opinions pertaining to double and single roving differ among spinners. Double roving is found more in the American mills than in the mills of any other country. It is customary in all other countries on both mule and ring frames, to use single roving for yarns up to 50s. For finer than 50s double roving is used. Out of the same cotton, double roving will, no doubt, make a stronger yarn than single roving, but at a greater cost. The points raised against double roving are as follows: Sometimes the two strands will separate for a distance, and when they come together again, they pluck some of the clearer waste hanging down from the flannel between the rolls—more so between the middle and back rolls. The next point is that the excessive draft usually required when using double roving in most mills, nullifies to some extent the advantage of doubling. Again, this required excessive draft offers much more resistance to the front roll than when using single roving, which necessitates increasing the pressure upon the top rolls. When the pressure upon the top rolls is increased, the consumption of power required to drive the frame is greater. On the other hand, it must be admitted, that when we double the roving we double the doublings, and we know that doubling is the most essential feature of any cotton mill. Now, why do we double the strands at every opportunity in a cotton mill? Is it not to remedy bad places in the strand? When we

REDUCE THE DOUBLINGS

one-half, as is the case when we run single roving, we multiply trouble two-fold. The production will be lessened, besides making imperfect cloth. As we see it, a cloth produced from double roving has a much smoother face than a cloth produced from single roving. The reason for this is that double roving makes a more even thread than single roving, consequently, it does not require as many turns to the inch.

Let us assume that we are running double roving on a ring frame, and that one strand has defective places. It should be seen that when the drawing rolls act upon the two strands the fibres of the defective places are mixed with those of the perfect strand and the defective places are remedied enough to carry the strand from the roll to the bobbin with the same amount of twist per inch. On the other hand, when running single roving, the weak places are drawn more than the perfect places, because the lighter the strand, the less friction on the front roll, and the light places are drawn still more which again weakens the defective places.

So from the above it can be seen that more twist must be inserted in single roving, if the strands in both systems are made out of the same cotton. Again, it should be seen that if we are running double roving or two into one at the back of the intermediate frames, and one end breaks back for a short distance, this end is pieced up again without pulling off the defective place in front, and that it will cause only a variation of one-fourth when using double roving and one-half when using single roving.

No experienced mill man will deny that double roving will make a smoother faced cloth than the single roving, and that the double roving system should be employed

WHEN MAKING SATEENS.

Sateens will show up the above two systems more than any other kind of cloth, owing to the amount of filling floating to such a large extent on the face of the cloth. The above is the reason why mule filling is preferred for sateen cloth. In summing up the above, it should be seen that yarn made from single roving is not as uniform as yarn made from double roving, and it is admitted by all experienced ring spinners that the most twist always runs to these weak places which increases the uneven appearance of the yarn.

The above is the very reason why very little filling yarn is made from single roving. The twist running to the weak places does not affect the warp yarn, except in strength and appearance, but with the filling yarn, it is different, as it is taken from the frame to the loom, and even if it is properly moistened, when the coils are unwound in the shuttle at the loom, the twist will run to the weak places and cause the yarn to become kinky. Kinky yarn is found much more where single roving is used for the reasons stated above. The breaking strength of warp yarn made from double roving is about 4 to 6 pounds better than yarn made from single roving with the same kind of cotton.

No. 113.

CXIV. BREAKING STRENGTH.

Although the difference in breaking strength between the two systems is not so great as one would expect, it is, however, noticed more at the warpers. We would suggest to all manufacturers who are contemplating changing from double to single roving, that they change only enough frames to run one warper, and to keep a weekly account of the number of end breakages on the warper running yarn made from single roving and on the warper running yarn made from double roving. If the above test is made for four or five weeks, the difference of breakage will be found to be so great that the conclusion will be that the only way to make an even strong thread is with double roving. Weak yarn is found often when double roving is used, and the reason is that the mill is spinning yarn that is too fine for the cotton used.

No manufacturer should expect number 40s made from

ORDINARY UPLAND

cotton to break at the standard weight, because we think when 30s yarn is made from the above cotton the limit has been reached. The yarn that gives the most trouble in a cotton mill is cut yarn, and in most cases, it is a trouble that is hard to locate. The chief causes of cut yarn are either that the gears are not set deep enough and slip one or more teeth occasionally, or one or two teeth may be broken out. When any cut yarn is discovered, the gears on all frames should be examined.

From what we have said it must be admitted that the more freedom the front top roll has to revolve the evener the yarn will be, and in order to give the front roll all the freedom possible, the top clearers should be made as light as possible, and the clearer cloth, instead of being glued on the board as found in some mills, should be mounted on wires that can be sunk in the board so as to have the clearer cloth just touch the top rolls.

Some mill men conceived the idea that a heavy clearer board stops roll lapping, and many mills have lately discarded their short clearer boards and are now using clearer boards double their length, while other mills have had their clearer boards bored and lead and other material of a heavy nature inserted so as to make them as heavy as possible. A heavy clearer is a step in the wrong direction, and to the writer, such an idea appears like a man setting his house on fire and then trying to put it out. When an end breaks and the strand follows the boll, instead of making the clearer heavier,

why not get at the root of the evil? If the grain of the leather covering is smooth, the strand will not follow the roll whether the clearer board is heavy or not, but, on the other hand, if the grain of the leather is roughened, the strand will follow the roll whether the clearer board is heavy or not. So in order to stop roll lapping, we must keep the roll surface as smooth as possible. The more frictional contact on the top roll, the more the grain of the leather is worn, and the rougher the surface of the roll will be. So any resistance offered to the front top roll will increase the frictional contact between the front steel roll and the front top leather roll, and the heavy clearer increases the friction. An excessive draft will cause frictional contact, and other defects that have been explained elsewhere will offer a certain amount of resistance to the top roll. The sides of the flutes of a steel roll are made sharp, so that a firm grip will exist between the rolls and a uniform draft can be obtained. If there is no frictional contact, the sharp flutes will do no damage to the grain of the leather covering. On the other hand, if any resistance is offered to the front top leather roll, causing it to lag behind, which we term frictional contact, this causes the grain of the leather top roll to be rubbed by the sharp flutes of the front steel roll, and in a very short time it will wear the grain of the top leather roll enough to make it very rough. This is the cause of the strand continually lapping around the front leather roll when an end breaks. From the above, it should be clear to the reader that increasing the weight of the clearer board increases the very ill that these men are trying to cure. No. 114.

CXV. SPINNERS' GAUGES.

All guide wires should be kept carefully set, so that the point where the thread rests will be directly over the centre of the spindle. Many spinners have gauges to set the guide wires which consist of a small rod attached to a small straight edge. The straight edge is laid on the roller beam and the small rod is put into the circular hole which the guide wire forms, and if the rod does not come exactly over the point of the spindle, it is made to do so either by screwing the guide wire in or out, or bending it slightly sidewise. The latter method is wrong, both in practice and theory, and you will find where it is employed that the spinner is continually ordering guide wires. The reason for this is because in the

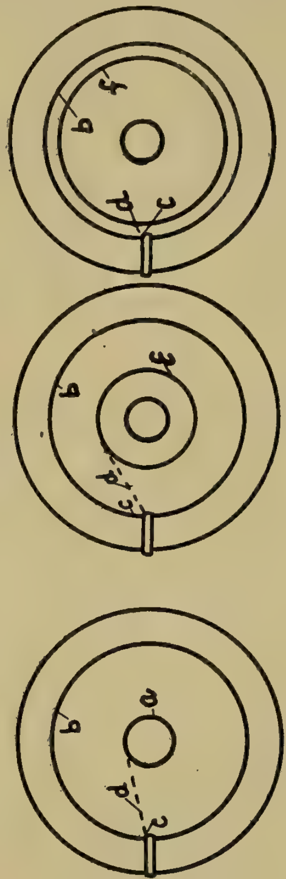


Fig. 36. Position of Yarn Passing From Traveller to Bobbin.

latter method the point where the thread bears comes on the side of the spindle instead of in the centre. The strand from the guide wire forms what may be termed a slight angle, owing to the point where the thread rests being always on the same side of the spindle. Consequently, the thread is not so liable to change its bearing point. On the other hand, when the point where the thread rests

is set so that it will be directly over the

CENTRE OF THE SPINDLE,

the end has a tendency to leave the bearing point, but is prevented from so doing by the tension on the strand; thus we create a vibration on that strand that gives it the appearance of two strands.

When the part of the circle which the thread guide forms comes directly over the centre of the spindle to cause vibration as explained above, the guide wires are seldom if ever changed. Even when the bearing point is set directly over the centre of the spindle a rough place will at times arrest the strand and hold it in one position long enough to crease the ring, but this seldom happens. When guide wires are set with a gauge, as described many guide wires will be found creased. Guide wires should not be used after they become creased.

Catalogues obtained from some builders tell us to set the thread guides directly over the spindle, and no doubt such a statement is responsible for setting the guide wires by gauge as described above. The reader should notice the difference, and instead of having the circular hole which the guide wire forms directly over the centre of the spindle, have that part of the circle where the yarn bears directly over the centre of the spindle. When a traveller breaks or flys off the end will kink fast, and at great lengths, this is because the yarn is not held and is free to unwind which it does. Besides, the drawing rolls are constantly delivering the same amount of yarn.

THE BOBBIN REVOLVING

at the same rate of speed causes these long kinks to fly out and become entangled with adjacent ends, in most cases breaking them down. A notch is cut at the end of the guide wire hanging downwards and is called a kink arrester. This notch catches the strand as soon as no winding-on of the yarn takes place, and at the same time it cuts the yarn. Thus the kink remains in the notch for a time, while the end of the yarn is wound on the bobbin, without any damage to the adjacent ends. From the thread guide the yarn passes to to the traveller, which is a small steel clip mounted on a flanged ring and is free to revolve thereon as it is dragged around by the end. There are many mill men to this day who believe that the traveller puts in the twist. This is an erroneous idea, and the fact is proven at the mule where there is no traveller and any reasonable amount of twist can be inserted on the mule. All students should remember that what we have said about twist on fly frames holds good here; that is, the strand or thread must be held at one end and held and revolved at the other. In order to understand the manner in which the twist is inserted in the yarn, we will first consider

THE TRAVELLER REVOLVING

at the same rate of speed as the bobbin.

As is well known by most mill men the end drags the traveller. It can be seen from the above that the traveller must lag behind the bobbin in order to wind the yarn on the bobbin. No. 115.

CXVI. THE TRAVELLER.

If the traveller was made to revolve at the same rate of speed as the bobbin, no winding-on would take place but the twist would be inserted. For the convenience of illustration we will assume that the bobbin is 1 inch in diameter and that it makes 9,000 revolutions per minute, also, that the front rolls deliver 500 inches in one minute. 1x3.1416x9,000 equals 2,827 inches of yarn the bobbin has a tendency to wind. If the traveller did not follow the bobbin and lag behind in the first place, the yarn would break between the front rolls and the bobbin, in the second place no winding would take place. So in order to wind the yarn on a bobbin, and at the same time put in the twist, we must employ a traveller in ring spinning. In order to wind

the yarn on the bobbin, the traveller must make the same number of revolutions equal to the number of revolutions made by the bobbin less the number of revolutions required by the bobbin to take up the yarn delivered by the front rolls. From what has been said, it can be seen that the bobbin has a tendency to wind on more yarn than is delivered by the front rolls which

CREATES A TENSION ON

the yarn, and this tension, which exists all the time the frame is in operation, is transmitted to the traveller and causes it to revolve around the ring but gradually lagging behind. Let us again assume as in the last example that the front roll delivers 500 inches per minute and the bobbin is 1 inch in diameter. In order to find the number of turns the traveller lags behind, we divide the circumference of the bobbin into the number of inches of yarn, the front roll delivers per minute. 500 divided by (3.1416x1) equals 159. 9,000 divided by 159 equals 8,841 revolutions of the traveller per minute.

Now if the front roll delivers 500 inches while the spindle is making 9,000 revolutions and the traveller must lag behind 159 inches in order to wind the yarn on the bobbin, we lose 159 turns of twist in the 500 inches of yarn delivered. So it is impossible for us to agree with most writers that give us the rule of dividing the number of inches delivered by the front into the revolutions of the spindle to find the twist per inch. But instead, using the above example, we have 8,841 divided by 500 equals 17.68 turns per inch. From the above it can be seen that the traveller lags behind much more at the beginning of the bobbin than when nearly full or filled. As stated the front rolls deliver the yarn at a constant

RATE OF SPEED,

so it should be clear to the reader that more coils are needed on the empty bobbin to wind on the yarn delivered by the front roll. Again, it should be clear that if it takes less coils as the bobbin fills, more twist is being inserted in the yarn as the diameter of the bobbin becomes larger.

The difference, however, is slight and is seldom if ever considered. However, the above subject has caused so much trouble and is so misunderstood that an explanation is worth while. It only takes a little scrutinizing in many textile books on the market to learn how such books as a rule are misleading.

Look up the above subject in Nasmith's "Cotton Spinning", and you will find on page 341 and 342 paragraph 295, the following: "Thus, the yarn when held at the base of the cone formed during building is—if the full bobbin be 1⅝ inches diameter—being carried round through a space of 4.31 inches at each revolution. When it is held on the surface of the bare bobbin, which is three-quarters inch in diameter, it only travels at the rate of 2.35 inches at each revolution. It is thus clear that, if no retardation of the traveller took place, it would travel during each revolution of the spindle a distance equal in each case to that stated. The effect of this upon the twist is easily seen. Suppose that 100 revolutions of the spindles are made in each case, and the rollers deliver five inches of yarn, the effect would be that the traveller in one case would travel 431 inches, and in the other only 235 inches. The circumference of the ring being 5.1, this means that the traveller makes 84.5 and 46 revolutions respectively. There would thus be introduced into the yarn 16.9 and 9.2 turns per inch respectively at each of these periods, which is a considerable variation." Reader notice the variation, 16.9 minus 9.2 equals 7.7 turns.

No. 116.

CXVII. TRAVELLER RETARDATION.

Now let us reason together and take every item apart given above and let us examine them. We will figure every item to prove each case,

and at the same time, show how the above is misleading. We first calculate the surface a the beginning of the bobbin and the full bobbin. ¾x3.1416 equals 2.35 circumference of empty bobbin, and 1⅜x3.1416 equals 4.31 circumference of full bobbin. Now let us reason the first statement, if no retardation of the traveller took place it would travel 5.1 inches or one circumference of the ring whether on the bare or full bobbin. This is not an accepted theory, but a fact, because the yarn is passed under the traveller and circles the ring in proportion to the amount of yarn that is delivered by the front rolls. Supposing 100 revolutions be taken in each case and the rolls delivered five inches of roving. The traveller in one case would travel 510 minus (5.00 divided by 4.31x5.1) equals 504.09 inches when on

THE LARGER DIAMETER

and 510 minus (5.00 divided by 2.35x 5.1) equals 499.188 inches when on the smaller diameter. The circumference of the ring in each case being 5.1, the traveller makes 504.09 divided by 5.1 equals 98.84 revolutions, losing 1.16 turns in winding five inches of yarn on the large diameter of bobbin, and 499.188 divided by 5.1 equals 97.88 losing 2.12 turns in winding on five inches on the small diameter of bobbin. We next find the twist 98.84 divided by 5 equals 19.76 turns to the inch when the bobbin is large, and 97.88 divided by 5 equals 19.57 equals turns to the inch when the bobbin is bare; 19.76 minus 19.57 equals .19 of a turn per inch in difference and not 7.7 as given. So we think the above verifies our first statement that the difference is so slight that it should not be considered. Another point that is misunderstood by many spinners is the amount of pull which is found much greater when the bobbin is bare than when nearly full or filled. In order to quickly understand this feature, the bobbin should be pulled off the spindle and the end wound around the spindle, and if examined it will be found that the end is almost in the centre of the ring. It should be seen that the more the end is toward the centre of the ring, the more pull is exerted on the yarn by the bobbin necessary to set the traveller in motion. Figure 36 shows the position of the yarn as it passes from the traveller to the bobbin, at (A), the circle a, represents the

OUTSIDE OF THE SPINDLE

and b represents the inside of the ring; c is the traveller under which the yarn line d passes to the spindle. At (B) Figure 36, is shown the bare bobbin on the spindle, while f at c shows the nearly filled bobbin. It can be seen at (A) that the line d almost coincides with the radius of the ring, and as stated this position of the yarn tends to draw the traveller towards the centre of the ring instead of around the ring like the position of line d and b, thus taking the yarn around the ring as is desired, and with much less pull, owing to the position of line d having a tendency to revolve the traveller around the ring instead of having a tendency to draw it towards the centre of the ring. The above is the chief reason why many spinners adopt a filling bobbin with a large barrel. Again after many years it was discovered that a bobbin having a diameter of ⅞ of an inch with a 7-inch traverse as a rule gives the best results for warp wind. It can be seen that the effect of the traveller on the yarn is not the same throughout the set, and it is a defect that is somewhat troublesome after doffing. The above defect has not as yet been successfully met by builders of ring frames, and any improvement in this line would be welcomed. Travellers as a rule are run at a very high speed, and to meet this they should be carefully made, and from the highest grade of steel. But although

TRAVELLERS ARE MADE

with the greatest amount of skill and exactness, it must be said that it is impossible to harden and temper them always the same

The above can best be understood by taking into consideration the different kinds of tempered razors we often find, and many times the cheap razor is much harder and of a better steel than the costly one. When we get a poor tempered razor we have trouble and the same can be said with the traveller. The above is given simply to show that at times trouble with the travellers is inevitable and it does not pay sometimes in being too hasty in making a change. Always keep trying new travellers but be mightly careful to pick the best and do this for the good of the plant —be honest. The round point travellers are much preferred, because it has been found that the rings will become wavy sooner with the square point traveller than with the round point. No. 117.

CXVIII. TRAVELLER TROUBLES.

In studying the path of the traveller, the reader must firmly fix in his mind what was said above; that is, regarding the yarn having a tendency of pulling the traveller to the centre of the ring more when the bobbin is empty. Now let us consider a few mistakes the thoughtless spinner may make. Like the front roll the traveller must have

A FREE PASSAGE,

but at the same time like the front roll drawing the fibres the traveller too has its duty to perform, and it must keep the tension as even as possible when the yarn under its action is suitable to its weight.

This is the very point that is most misunderstood by spinners, because many spinners will put on a light traveller to ease the tension at the beginning of the set, never thinking that they are injuring the rings.

Now let us ask what makes the rings wavy? Surely the traveller must be interfered with—it must be pulled out of its path or else it would wear the ring evenly.

Let us see what happens when a spinner puts on a lighter traveller to ease up on the yarn at the beginning of the set so that there will be less breakage of ends after doffing.

From what has been said the reader should see that if the tension is just right at the start it will be much too slack when the bobbin fills, which will cause the yarn to balloon and strike the blades of the separators and adjacent ends.

When the yarn strikes the blades of the separators, the adjacent ends, or the top of the bobbin on which it is wound, the traveller is affected correspondingly, because when

A SLIGHT PULL

is given to the yarn the traveller is lifted. When the traveller is jerked a couple of times at each revolution it takes but a short time to wear out hollow places here and there on the surface of the ring. Expert ring spinners tell us that rings should run at least five years without changing.

The writer knows of a mill where the rings are running ten years without changing, and they look good for ten more. I know many spinners will take exceptions from the above statement, but the writer will direct any skeptic to this very mill. No spinner can deny that all rings would be worn evenly if the path of the traveller was not interfered with, and if the above is true, then every spinner should study the different defects that will cause the traveller to lift. Uneven numbers will wear the rings wavy, because it is impossible to have on the proper travellers when the yarn is uneven. This causes the heavy ends to balloon and what has already been explained occurs. When the top rolls are not properly set light places are introduced here and there on the yarn, which will cause the traveller to jump. One of the worst evils existing to-day in many spinning rooms is having the ring rails travelling very fast. Why this is done is unknown to the writer, but I do know that

TROUBLE IS FOUND

where such conditions are found. This is more injurious to the rings on the filling wind than on the warp

wind, for the reason that the traverse is changed a greater number of times, and besides the rail traverses much faster one way. We have pointed out how the yarn will act on the traveller so as to injure the ring, but it must be remembered that the travellers at times have a bad effect upon the yarn, especially if they are worn. As a rule, the travellers on fine yarns break as soon as they are worn. The reason for this is that there is very little body to begin with, and besides some spinners running combed stock carry much tension on the yarn in order to get all the yarn possible on the bobbin, and although this necessitates a little heavier traveller, they will fly off when they are slightly worn under the above conditions. The travellers should be changed systematically on medium or coarse work—change oftener on the coarse work. We find in many mills to-day no system in changing travellers, and they are seldom if ever changed, but instead they are let run until they fly off. Very few ring spinners consider the injury a worn traveller will cause to a ring, simply because the effect can not be detected by the naked eye. Examine the

PATH OF THE TRAVELLER

when the sun's rays are upon the ring, and it will be found that the traveller has no bearing on the outside of the ring. This proves that the centrifugal force of the yarn is stronger than the pull from the traveller to the bobbin, as the traveller runs always on the inside of the ring. If the pull from the traveller to the bobbin was greater than the centrifugal force of the yarn, we would not have a constant series of alternate accelerations and retardations of the velocity of the traveller as found on all ring spinning frames of to-day. From the above it should be seen that there is much to a traveller, and that many dollars can be saved yearly by giving them proper attention and care. It will pay any spinner to examine the path of the traveller when the sun's rays are upon the ring, for he will then be convinced by the position of the traveller that the centrifugal force of the yarn is stronger than the pull from the traveller to the bobbin. It will be seen at a glance that the centrifugal force of the yarn tends to keep the inner point of the traveller on the inside surface of the ring, and, as we stated, any effect upon the yarn is of course transmitted to the traveller and acts upon the rings as described with the result of a wavy ring.

Travellers are numbered by a scale commencing with the heaviest

AND BECOMING LIGHTER

as the numbers are reduced. As a standard a number 1 traveller weighs 1 grain. When travellers are lighter than 1 grain, they are then numbered by whole numbers with 0 added from 1-0 to 25-0. It must be understood here that although the same numbers are used by different makers of travellers for designating their different sizes, that these numbers do not indicate the same weight in all makes. As was stated, the traveller should have the least resistance possible, so the ring on which it is mounted is made of steel and perfectly smooth. There are at present on the market rings that are known as the mirror rings, and with their use, the changing of travellers is unknown. Their surface is so smooth that a much heavier traveller can be used and at the same time not have as great a tension on the yarn as is found on almost all other makes. The size of the ring is determined by its inside diameter, a ring measuring 1⅝ inside being called a 1⅝ ring. When spinning filling a smaller ring than when spinning warp should be used. There are two reasons for this: 1. The filling yarn is not twisted as much as the warp yarn, besides it is finer and of course weaker, and will not stand the

EXCESSIVE TRAVELLER PULL

that exists when the ring is too large. 2. It must be remembered when changing from warp to filling that there is a limit to the size of the

filling bobbin that can be placed in the shuttle, and for this reason, when changing over from warp to filling wind, a bobbin should be obtained and the bobbin constructed according to the shuttle. No. 118.

CXIX. SPINNING RINGS.

There are different kinds of rings, some containing one flange and others two, but those with two flanges are mostly used, for the simple reason that they can be turned over and used as new rings. Many spinners claim that when rings are turned over the surface has contracted rust, besides they claim that when the ring is forced into the recess in the upper part of the holder the surface of the ring is roughened. All experienced spinners know that the above claims are wrong, because from what we have already said, it should be clearly seen that the traveller travels on the inside of the flange as was explained. To prove the above, take a badly worn ring, and the inside will be found wavy, while the outside will be almost new, which proves that the traveller does travel on the inside of the flange, and that any roughness upon the outside surface of the ring, caused by the holder,

WILL NOT AFFECT

the traveller. As it looks to the writer, the use of single flange rings is a waste of money, and the claims against the double flange we think have been proven worthless, and you will find in most cases where the overseer will put up a strong argument against turning rings over on account of the small nicks that may be caused by forcing the ring in the upper part of the holder, that they themselves will allow the rings to become ruined by allowing the help to break off travellers with clearer boards, bobbins and top rolls. When travellers require changing, they should be pulled off and not broken off. A small hook should be used, and the point of the hook should be placed under the traveller and then the hook should be pushed towards the centre of the ring. In most all our cotton mills to-day the travellers are pulled off with a small hook, but they are pulled from the outside, and from what we have said it should be seen that this method will affect the path of the traveller more than when the travellers are broken off. When a

TRAVELLER IS WORN

it will be found by putting the forefinger on the traveller, inside the ring and the thumb on the outside, then moving the finger to the left the sharpness on the right hand side of the traveller can be detected. Now if we imagine the traveller to be pulled off by pulling the traveller to the outside of the ring, it can be seen that this sharp place will cut a nick in the inside of the ring—the very path of the traveller. On the other hand, it is well known that the traveller travels on the inside of the ring and that very small nicks on the outside of the ring will have little or no effect upon the path of the traveller; so by pulling the travellers off by pushing the hook towards the centre of the ring, the inside of the ring will be saved, as also the outside, because the traveller never wears on the outside of the ring, but remains in a smooth condition.

Remember this, that a poor ring will destroy enough travellers every five or six months to pay for a new ring, not considering the amount of waste that will be made from the spindle, and poor yarn besides. Many builders advocate crowding a small piece of tallow between the neck of roll and stand in order to keep the bottom steel rolls well lubricated. We know from experience that using tallow in any form is bad for spinning, and all rolls should be oiled. The chief aim of every good spinner is

TO AVOID OILING

the rings. All builders of ring frames advocate this, because such a practice has been found to be detrimental to the spinning.

But the above is just what happens when tallow is used, for the reason **that the spinners are continually tak-**

ing a small portion of this tallow to put on a dry top roll, then they will replace a broken traveller without even wiping their hands, thus oiling the ring. When such conditions exist in any spinning room, it will be found that so many ends will have the proper tension and so many will whip. From what we have said, it should be seen that using tallow on the rolls will eventually injure the rings. One point the writer wishes to convey to the manufacturers, and that is, to not take so much notice of most selling agents. Most of these men unconsciously cause many hours of worry to many overseers. For instance, it was only a few days previous to this writing that the writer had the pleasure to have about one hour's talk with a Fall River mill treasurer. He said that he had just been given a good idea from a selling agent, which he thought would save the mill much money. The following is the idea: Spinners should be taught to feel of their travellers every time an end is pieced, and when any roughness is found on the right hand side of the traveller, (chiefly where the wear comes) to pull the worn traveller off. All ring

SPINNERS WILL TELL YOU

to-day that the chief defect in a ring spinning room at the present time is poor help. Again, the demand of most manufacturers for the greatest possible production from the machines causes him, in most cases, to lose sight of the fact that the help in this department is much poorer than it was years ago. So we must give a spinner as many sides as possible to make a fair wage, and in many mills, most spinners are given more sides than they are able to run, consequently, the quality and quantity of the work suffers. From the above, it should be seen that manufacturers do, as a rule, take too much notice of these selling agents, because most spinners will agree with the writer, that it would be almost an impossibility to carry out such an idea. The poor help is noticeable, particularly in prosperous times, when the manufacturers are running their front rolls at a maximum speed, and constantly calling for as much work as possible from their plant. Of course, this is only natural for the manufacturers to do, as it is well known that increased production means larger earnings, but it must be said that in a good many instances, it is carried to extremes, and there is no doubt that the majority of the bad work from this department comes from such practice. These are the things that should be considered, and besides,

IT IS DOUBTFUL

if it is possible to train help to be so skillful, because there are very few employed in a ring spinning room that can detect a worn traveller. The best way to do when a selling agent claims that the carder or spinner is a poor man, is to have him meet the carder, or spinner, and let him point out the defects to these men, and give them a chance to defend themselves. All up-to-date manufacturers know to-day, that all machine builders give in their catalogues tables for production for both warp and filling which are altogether too high for the quality of cotton used in most mills, still it was only a short time ago that these very men, whom the writer refers to above, advised the manufacturers to follow these tables, claiming that they could if they had charge of the room. Rings are supported by holders, which may be either of cast-iron, known as the box ring holders, or steel plate. Holes are cut in the ring rail for the reception of the holders, and the holes are made slightly larger than the outside diameter of the holder. The reason for this is to provide a ready means of making any necessary adjustment; thus the holder, with the ring can be moved together to any position within certain limits, and at the same time held in position by the screws that fasten the holder to the ring rail.

No. 119.

CXX. RING HOLDERS.

Many spinners prefer the box ring holders, because they claim that box ring holders hold the rail more rigid, which is accomplished by the should-der of the box ring, and as the ring rail must be perfectly level at all times, it is claimed that the aid from the shoulder of each ring precludes the possibility of the rail sagging in the centre. Although the above is true, it will be found that the ring rails employed with the plate ring holders, are just as rigid, owing to the holes bored in the rail being much smaller than the holes boared for the former type of holders. However, there is one point we wish to convey to the manufacturers, and that is, if a change is made in the type of ring holders, or in other words, if box ring holders are discarded for the plate ring holder, change the rail also, because it will be found that the space left after removing each ring, will weaken the rail to such an extent as to cause it to sag in the centre, and in most cases, will break from the least jar.

A good practice that will help the running of any spinning room is to make a trough of sufficient size to hold a portion of a ring rail, fill the trough with a solution of potash and place the rails in the trough, while the frame is being scoured, and then wiped. Have the trough in the fire-room. The above will remove any oil or tallow that may be on the rings, and a more even tension is obtained.

The spindles and rings form two of the most important parts of a ring spinning frame, and the successful and economical operation depends to a great extent on these two parts.

The chief aim of every builder is to have the rings forged from the very best stock, and then carefully hardened and inspected before they leave the shop. After the ring has been forged and properly treated to destroy the scale, they are machined. Great care, knowledge, and skill are required in forging the blanks from which the rings are turned. The mechanic must learn all about the nature of the material, and he must also comprehend the natural laws which regulate the operations connected with his particular handicraft, because any large excess of heat, or not heat enough means spoiled forgings. The above short description of ring making is given simply to show how all rings on every new frame should be examined. The hardening of the rings is also important, but no spinner can tell whether a ring is hard enough, unevenly hardened, or hardened too much by looking at it. He must

TEST THE SURFACE

of the ring with a file or something of a hard nature, and this he can not do on a double ring. Rings that are untrue in roundness, need re-polishing or, for any defective tool work, are not perfect, the spinner should be able to detect on examination. The writer has in mind a mill where its up-to-date spinner threw out over 30 per cent of the new rings received at the mill, owing to defective tool work.

The early type of spindle was similar to the mule spindle, and was sustained by a foot-step and bearing consisting of considerable weight. The special feature of all up-to-date ring-frame spindles is that it is allowed to find its own best centre of rotation within certain limits, with a bearing well within the bobbin, thus reducing the excessive vibration and wear that was found on the older type. There are numerous types of ring-frame spindles on the market, and the purchasing of the best type is an important consideration, because in some cases the frame is made in one shop and the spindles in another, so it is not necessary to adopt any one make of spindle with any particular make of frame. Spindles, as a rule, are much neglected in our cotton mills. Some spindles are oiled every four weeks when they should be oiled every two weeks; others are oiled every two weeks, and are not as well lubricated as those oiled every four weeks owing to the poor quality of oil. Buying a

cheap spindle oil is false economy, and if the evils that poor oil cause were understood by mill managers, very little poor spindle oil would be used.

No ring-frame spindle, no matter what type should be run over 9,000 revolutions per minute. No. 120.

CXXI. WHITIN SPINDLES.

Figure 37 is a perspective view of the Whitin spindle. From the figure it can be seen that the whole structure of bolster, spindle, bobbin, and its yarn load rests upon a solid pin milled into the bottom of the outer casing. The inner casing is slightly smaller at the bottom than the inside of the outer casing, which allows the base of the spindle blade a slight lateral movement, thus permitting the spindle to find its own centre of rotation within certain limits as stated. To prevent the escapement of oil that the high speed of the spindle naturally works out under the whorl, a small ring, extending down a short distance into the bolster, is driven onto the spindle under the whorl. By again referring to the figure, it can be seen that the oil is admitted to the spindle bearings through two small ducts. Thus it can be seen that the main supply of oil is not agitated by the motion of the spindle, and all dirt settles at the bottom of the bolster case. This feature is

A GREAT SAVING

to the wear of the spindle and bolster, because the less we disturb the oil the less dirt we agitate, and the cleaner the space between the spindle and bolster. The writer has in mind a mill that has run the Whitin spindles for 15 years without changing a spindle or bolster on account of wear, the spindles making 9,000 revolutions per minute.

The spindle carries a whorl, which forms a pulley for the spindle band to drive the spindle. There is a tapered steel bushing that fits the inside of the bobbin. The Woodmancy doffer guard and oil cap is also shown. It consists of a cap, or cover, hinged to the enlarged portion of the upright oil tube. By closely examining the figure, it can be seen that the portion nearest the spindle projects beyond its hinge and forms what might be termed a hook over the spindle whorl, in order to prevent the spindle from being re

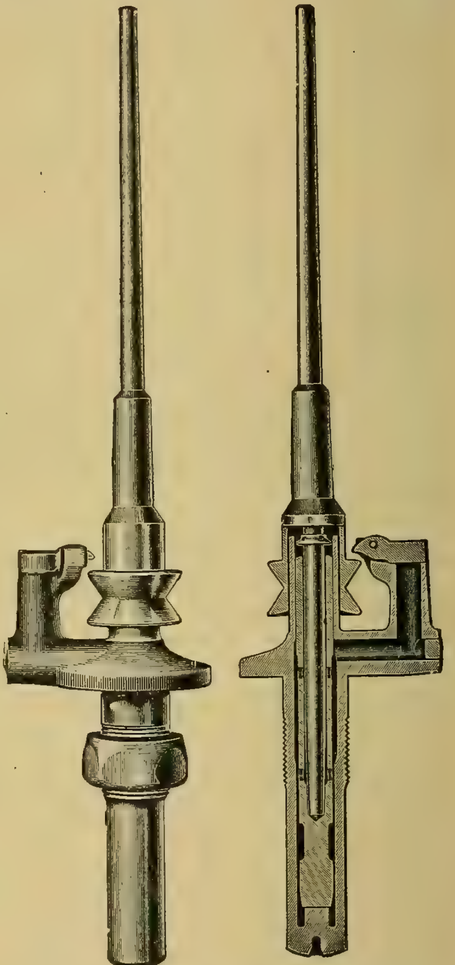


Fig. 37. Whitin Gravity Spindle.

moved from its position in its bolster when the spindle is in operation. The cap or hook is needed most on a frame that is speeded too high, especially if the taper at the base of the spindle is great and the band tight, for there will be a tendency for

the spindle to be continually rising, which causes the coils to ride one another, and introduce much breaking at the spooling.

It is claimed for this spindle that its superiority is largely due to the arrangement of the parts of the bolster as stated, and the placing of its case opposite the centre of the whorl. Again, the sliding-fit between the interior and exterior cylindrical surfaces of the bolster case and bolster respectively allows the foot of the bolster

SUFFICIENT PLAY

to remove any tendency to rotate. From what we have said above, it can be seen that with these surfaces arranged as described, and with the band pull at or near the middle of the surfaces, the spindle is kept in a vertical position at all times. The power of the band is exerted to bring these surfaces in alignment, even when the unbalanced load tends to throw the bottom of the bolster out of its central relation. Thus, if the ring is properly set, the spindle remains true with the ring. The band pull does not deflect the spindles, whether tight or loose, and no influence is felt by it on the spinning of yarn. The position of the whorl is such that an even pressure is exerted upon the whole length of the spindle bearing. The only point against this spindle is that as it wears it cannot be adjusted like many other types. The writer looks upon this as a good point instead of a bad one. The spindles are properly set before they leave the shop, and they require no resetting, as is the case with many other types, and the only thing to do is to replace the worn part. If the proper oil is used, it will be found that very little wear will occur. No. 121.

CXXII. DRAPER SPINDLES.

Figure 38 is a perspective view of the Draper spindle. 1 is the spindle blade, 2 the sleeve whorl, 3 the brass cup, to aid in positioning the bobbin. There is a brass washer, forced on the spindle blade under the whorl, to prevent oil from escaping, as was explained on the Whitin spindle. 5 is the bolster, 6 the packing strings that secure the packing in position; 8

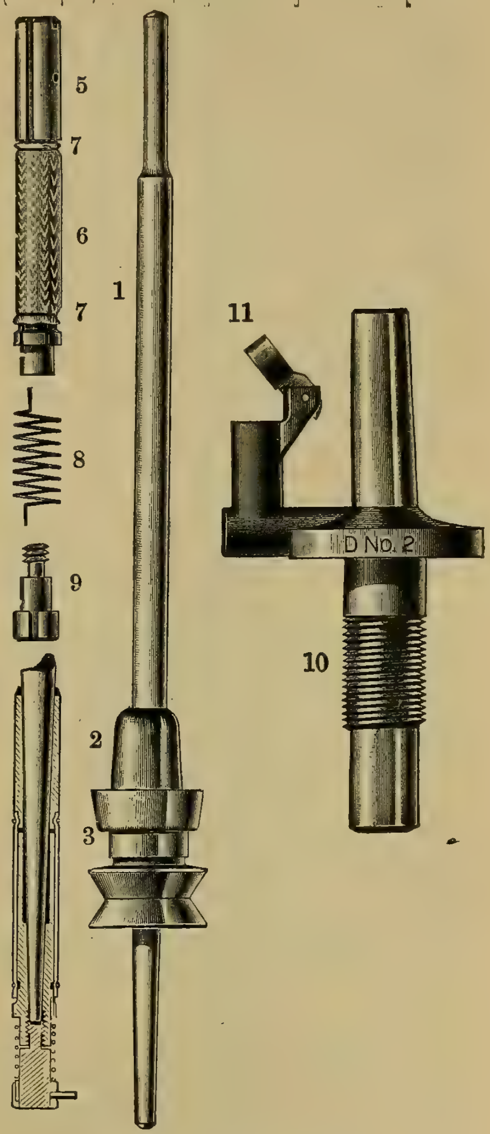


Fig. 38. Draper Spindle.

the spring to serve as a cushion for the spindle, 9 the step, 10 the base, 11 the cap or hook, and 12 the pin to prevent step from turning.

By referring to the figure, it can be seen that the Draper spindle differs in its details, principally in the construction of the inner casing. It can be seen that the bolster in the latter type is made up of four pieces; namely, the bolster, packing, spring and step. It will be noticed by examining the figure closely, that there is a notch cut in the step at every quarter of its surface, and the same at the lowest end of the bolster. Both of these slots engage with a pin in the base of the spindle. When any wear is discovered on this type of spindle, the bolster is removed from the base, and the step or bolster is turned one-quarter turn, so as to give the bolster a higher position; but it must be remembered that the spindle blade will remain at the same height.

If the bolster is raised too high, the spindle will bind, and if too low, the spindle blade will vibrate, so it can be seen that if the wear is slight enough to cause only a little vibration in most cases a quarter turn of the step or bolster will cause the spindle to bind, thus the spindle must not be disturbed until it wears enough so that the bolster can be raised to the amount of one-quarter turn. In order to overcome this, Albert H. Morton, superintendent of the Lowell Machine Shop, has invented a device by which the step and bolster are clamped together by a steel sheet tube that has a cut on its surface, so that it will act as a spring clamp with strength enough, it is claimed, to prevent either bolster or step from turning. As the spindle wears, 1,000 part of a turn can be given, and the spindle can be properly adjusted at all times. Although

THIS NEW DEVICE

is much appreciated and giving the best of satisfaction to the writer, it seems that the vibration of the mill aided by the weight and rotation of the spindle will in time affect the position of the step and and bolster, and although a much finer setting can be obtained with the above device, it must be admitted that locking the step and bolster together by the notches engaging the pin in the base is the safest method. The writer wishes to be understood, for although he thinks at present that after years of usage the above device may give trouble, to date, it has given the best of satisfaction. The Draper spindle is, no doubt, one of the best types on the market, but it must be said that it is the most misunderstood and most abused. You will find many spinners running the Draper spindle who will tell you that raising the bolster will raise the spindle and that lowering the bolster will lower the spindle. It was only a few days ago that the writer, while trying to convince a ring spinner that the above was wrong, was told that he, himself, would be convinced before he left the room. I was ushered to a frame, and there he pulled out the bolster and step, and turned the bolster one complete turn, and then replaced the spindle in the casing again. He called my attention to the fact that the whorl was closer to the Woodmancy doffer guard or hook, thus claiming that it was proof enough that raising the bolster did raise the spindle. My only wish is that the AMERICAN WOOL AND COTTON REPORRTE will reach every spinner that conceives the above idea so that they may have a chance to read the following explanations on the above subject.

EXAMINE YOUR BOLSTER

on the Draper spindle, and you will find the recess in which the bottom of the spindle blade rests is larger at the top, while the bottom of the spindle has a corresponding taper. The object of such a construction is to have a close fit at all times, and at the same time to relieve any binding action that might take place between the tapered spindle blade and the inner casing. Let us assume that we find a spindle blade that has a tendency to bind slightly, we at once turn the bolster one-quarter turn downwards, thus bringing the bolster to a lower position on the spindle, and as they are

both tapered, it should be seen that a slight movement of the bolster will make a great amount of difference in the space between the spindle blade and inner casing. On the other hand, if the bolster is raised slightly, we have the same effect, only the space between the spindle blade and inner casing is reduced. No. 122.

CXXIII. SPINDLE BOLSTER.

The following will prove that any spinner that conceives the idea that raising the bolster raises the spindle is wrong: 1. The screw which fits into the bolster serves as footstep for the spindle, and the spindle must rest at all times upon this step. 2. The footstep rests always on the inside bottom of the outside casing and occupies the same position at all times. From the above, it can be seen that when the overseer made a complete turn on the bolster, and raised the spindle, the spindle was supported by the recess in the bolster, and the spindle bottom was lifted from the step. On the other hand, if a spindle is found in the above condition, and the bolster is lowered, the spindle will be lowered also, owing to the fact that it is not resting on the spindle step. The above is the very cause of many frames using the Draper spindle, it being hard to drive. The Draper spindle has an advantage over many spindles in its construction, because when using the Morton clamp a snug fit can always be maintained as the spindle or bolster wears. On the other hand, the Whitin spindle's success does not depend upon the skill of those in charge, but, as stated, it is set at the shop and run in one position. It only takes a visit to some of our spinning rooms to realize how the Draper spindles are abused; for just look at the whorls and you will find them of different heights. It must be understood here that the Draper company are not to blame for the above existing conditions. The writer considers that it is without doubt as good a spindle as

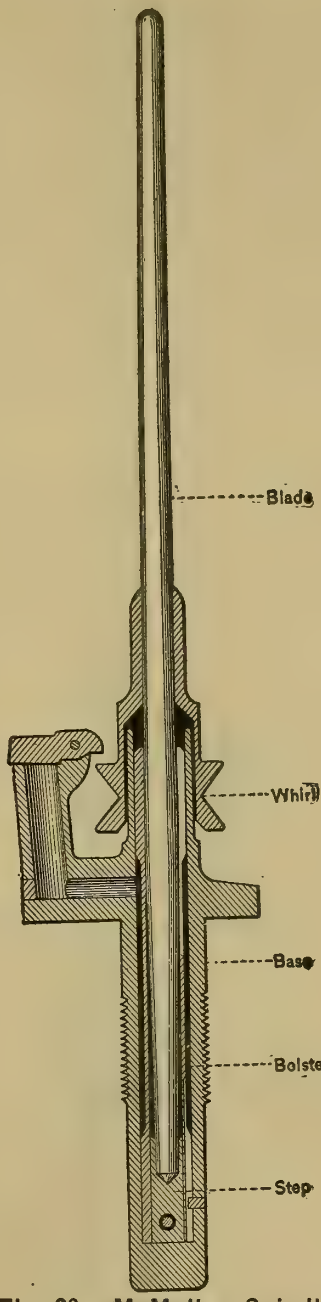


Fig. 39. McMullan Spindle.

found on the market if given proper care. The spring shown in the figure is seldom, if ever, used at present. One end of the spring,

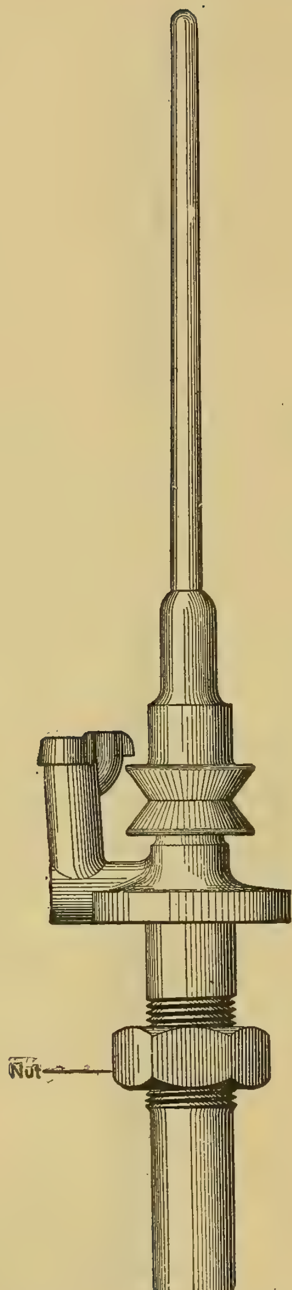


Fig. 39A. McMullan Spindle.

when used, was passed into a slot in the lower part of the bolster, while its other end was passed through a hole in the footstep. Its object was that in case any binding took place between the spindle blade and the bolster, the revolving of the blade would tend to turn the bolster down on the screw or step, thus compressing the spring. However, it was soon found that the spring was continually getting tangled, and many mills discarded them. Figure 39 and 39A shows

THE McMULLAN SPINDLE

which resembles, to a large degree, those already described. This spindle has a loose lock step wholly inside the bearing tube, which is itself loose, which permits the spindle to find its own centre, and locked in the outer case. Such a step, it is claimed, adds to the running power of the spindle sufficiently to admit the possibility of having the shank of the spindle blade made considerable longer, and the extra length of the spindle below the main bearing gives the latter little chance to vibrate; besides, it serves to keep the spindle erect. It is also claimed for this spindle that the very slight taper holds the oil on the bearing, and does not allow it to rise to the top in sufficient quantities to be thrown off, and too, the taper is so slight that it is impossible for the band, however tight, to raise the spindle from its step, as sometimes happens with some other types of spindle are well made and give admirable results. Below are the weights of the above spindles complete: Draper No. 4, 22 ounces; No. 3, 22½ ounces, and No. 2, 16¼ ounces. Whitin gravity, standard 14¼ ounces, medium 19 ounces, large 25 ounces. McMullan, standard 15 ounces, medium 15¾ ounces, heavy 17¼ ounces. No. 123.

CXXIV. SPINDLE POWER CONSUMPTION.

The elements of power consumption are the same on all types of spindles, but their proportion varies to such an extent with different forms that it is necessary to determine the absolute influence of each type separately. From what we have said, it can be

seen that the usual amount of lateral friction due to the tension of the band is the principal element of power consumption in a spindle. It has been pointed out also that the use of yielding bearings allows the speed to be increased without apparently increasing the vibration.

To Mr. Sawyer belongs the honor of first applying the above principle successfully, because it was he who first constructed a spindle with a bearing well within the bobbin. As we have said, the first type of spindle was similar to the mule spindle, and was sustained by a footstep and bearing possessing considerable weight. This required the use of a larger band, and the tension ran up to 15 pounds. In our cotton mills to-day using the modern spindles, the average pull is found to be from one to three pounds. Atmospheric conditions cause the variation, as one pound is ample for ordinary conditions, while over three pounds are necessary under certain others. It must be understood here that the above statement is not intended for a defective spindle. Granted that the spindle is in proper order, the usual tension has to be

HIGH ENOUGH

to allow variation, because bands are greatly affected by moisture and difference in temperature.

It is safe to say that it is impossible to have the proper tension on bands at all times in a spinning room, and the only way that it can be accomplished with our present banding system is by constructing the bands of a new substance.

All spinners of experience know that over eight per cent more power is consumed when the frames are started up in the morning than when the bands have stretched by one or two hours' running. Many spinners blame the band boys for bands breaking on a heavy day, when they should blame a slight rain storm instead. We have said elsewhere that using cheap oil is false economy, which is true, because spindles that are not properly oiled with good oil will allow the spindle to become dry, and grind out a great deal of iron at times. It can be seen that this dirt has a bad effect on the spindles, besides increasing the consumption of power. For the above reason, it is a good practice to take so many frames each week, if only two, and remove the spindle and bearings and clean the base with a suction pump. How many spinners know the actual revolution of their spindles? There is no doubt that if such a question is put to any spinner he will quickly answer you, and tell you the number of revolutions to the best of his knowledge, because, as a rule, the writer has found spinners honest in this respect. However, a short ime ago I inquired

THE SPEED

of the spindles in a certain room, and was told that they were making 10,600 turns. The writer has a device for timing spindles which will be described later. It gives the actual revolutions of the spindle. The above device was attached to the frame and to one spindle, and instead of getting 10,600 revolutions, we found 9,300 The spindle must be considered a small, upright revolving shaft, running at an extremely high speed.

Any defect that will offer any resistance to the spindle increases the consumption of power: 1. If the spindle shaft itself is necessarily somewhat imperfect. 2. If the spindle rests upon the bolster and not on the step. 3. If the bolster is too low which causes vibration. 4. The load carried by it, while performing work, the amount depending on the number of yarn and length of traverse. 5. The pull of the traveller. 6. The amount of tension on the band. 7. The size of the band. 8. The quality of oil used, which varies the co-efficient of friction. 9. Not oiled properly. All the above must be considered when timing spindle by calculations. Some allow 4½ per cent, which is found to be the average slippage, where the spindles receive proper care, but it is safe to say that in other mills, the slippage is often over ten, especially when the spindles are run on the bolster instead of on the step. No. 124.

CXXV. SPINDLE SPEEDS AND TWIST.

Some spinners are always in trouble for no other reason than not giving the spindle proper care, which affects the twist per inch in the yarn. Instead of allowing ten per cent for slippage, they only allow 4½ per cent, thus besides having poor spinning, the weaving is likewise affected—even the cloth will not stand the strain it has to undergo in the bleacheries or print works. The cloth will tear and in many instances has to be returned to the mill. Even when a proper device is used to obtain the actual speed of the spindle, it must be remembered that the twist per inch must not be calculated by the speed of the spindle, but by the speed of the traveller. The device to obtain the actual speed of the spindle used by the writer is a simple one. It consists of an angle made of brass, the part of the angle attached to the frame being about six inches long, while the other part that

HANGS DOWNWARD

beside the spindle is about seven inches long, and each part has a slot about 1½ inches long at each end.

Such a device is shown in Figure 40. A is the thread board, B the guide wire, C the nut and bolt that fastens the device to the thread board, D is the brass angle, E is a small spur gear that contains one hundred teeth of suitable pitch to mesh with the worm F that is forced on the spindle blade G; H is a little wire rounded in such a manner that it protrudes from a tooth of gear E, without offering any resistance to the meshing with worm F, and I is the spindle rail. The worm forced on the spindle is single and one turn of the spindle will move gear E the amount of one tooth. It follows that one hundred revolutions of the spindle will give gear E one complete revolution. The worm F

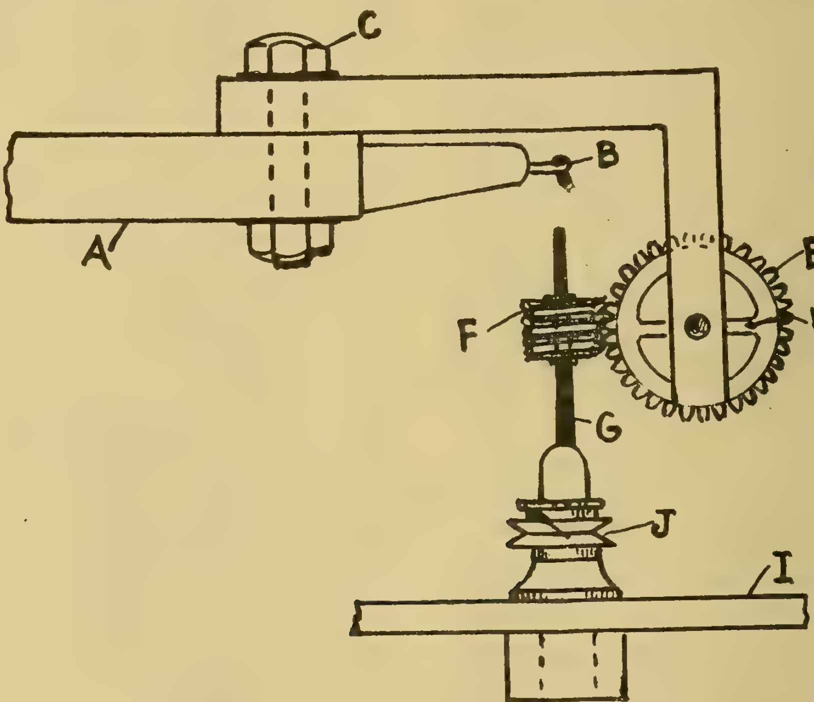


Fig. 40. Device for Ascertaining Spindle Speed.

should be bored to fit the upper part of the spindle blade with a hole having a taper corresponding to that of the spindle blade. In counting revolutions with this device, for example those of a front roll, or

A CARD DOFFER,

do not make the mistake made by most overseers of counting one as soon as the wire touches the finger when the hand of the watch is on the desired starting point. To illustrate this point, we will assume that we are timing a card doffer, and that at the start, as soon as the timing place strikes the finger, we count one, and if the doffer makes 12 revolutions per minute, it should be seen that we would count 13 turns. It can be seen that the above is an important point, and that it must be considered when timing a spindle. The average speed of a ring frame spindle is about 9,000 revolutions per minute, so that when timing the above speeded spindle, gear E will make 90 revolutions per minute, which is equal to 1½ turns of gear E per second. To be accurate requires the greatest care and attention possible when timing, because if only one second is miscalculated, 150 turns are lost. However, even if such a mistake was made, the results would be much closer than in the above case, because 10,600 minus 9,300 equals 1,300 in difference, while using the above device, the loss of a second only makes a difference of 150 turns. This is the only way to get the actual spindle speed, and if the above device is used, a good

MANY SPINNERS

will realize that they are not putting in the standard twist. We wish to remind the reader again not to figure the twist per inch from the speed of the spindle as advised by most all text books, and textile schools, but from the speed of the traveller. We have given elsewhere the rule for finding the speed of the traveller. To obtain the full value of the above device, it is first necessary to obtain the speed of a spindle in proper condition and banded with the ordinary tension. By knowing the proper speed of a perfect spindle, a great many defects about the room can be discovered, and the user will thank the day that the American Wool and Cotton Reporter gave the above suggestion. For instance, let us assume that we size the yarn and find it very even in weight, but very uneven in breaking, what is the cause?

No. 125.

CXXVI. POOR WARPING.

With the above device, the trouble can be quickly located, but instead of using a bolt to fasten the angle to the thread board, a screw should be used. All experienced spinners obtain what is termed a pick-up to produce average yarn. This means that the bobbins are obtained from different frames about the room, and sized. The carder is then advised of conditions found and he regulates his work accordingly. Now, why not use the above device on different spindles about the room to get the average speed, besides finding all kinds of defects?

As stated, by knowing the speed of a spindle in perfect condition, the instant that the above device is applied to any spindle out of order, the speed obtained will indicate that there is something wrong. Let us assume that when we size, one bobbin of 28s yarn breaks at 61 pounds and the other at 44 pounds. The above device should then be applied to the spindle from which the weak yarn was obtained, and if the spindle is up to the proper speed, the conclusion will be that the trouble is

IN THE DRAWING.

rolls, in the strand fed, or due to poor stock. On the other hand, if the spindle is not up to speed, the conclusion is that the trouble is either in the band or the spindle itself. The writer has often found a variation of 4,000 turns in different spinning rooms in New England, and a variation of over 1,000 has been found in every spinning room the writer has visited.

Let us ask what is done when the warpers are continually stopping from weak yarn? The cry is poor stock. But how is it that the roving will as a rule last a week, and we have good warping to-day and poor warping to-morrow. Most spinners will tell you that it is due to atmospheric conditions, and they are right, but what is done to help it? Nothing, in most cases.

The following is the trouble with poor warping in most every cotton mill:

If the spinner has only sufficient twist to give the yarn enough strength to unwind the spools at the warper under favorable conditions, it should be seen that on a heavy day, the frame spindles are not up to their proper speeds, besides the warper spools will offer more resistance on a heavy day which increases the amount of breakage. The yarn made on a heavy day will in most cases be felt for days after, because yarn as a rule is binned, and this weak yarn is mixed with

THE STRONG YARN

and poor warping is the result. As we have stated, the strength of a warp is governed by the weakest end in it. It follows then that it is the same with the warper; that is, one weak thread will possibly stop the warper 100 times.

As soon as a spinner complains to the superintendent about the roving breaking back, the carder is at once told to insert more twist in his roving, and the superintendent expects the carder to take the twist out again as soon as conditions warrant it, but here are the same conditions, the spools are breaking back from the lack of twist, and instead of inserting a tooth of twist for the time being, atmospheric conditions are blamed, or if the weather conditions have been favorable, and they can not blame the weather, they will blame the man that buys the cotton.

The reader should see that the above device will show all such defects, and when it is used, the spinner is sure it is not guesswork. No mill man can deny that the above are facts, because they know that in some mills,

THERE IS TROUBLE

with the spinning, the year round, while in other mills, very little trouble is found in the spinning. The writer has seen a mill running one-inch American cotton, the spinning being much better than another mill running one and one-eighth inch cotton. This proves that there is something wrong with the latter mill. For the above reason, many mills pay very little attention to the figured twist, but instead a small machine is used to extract the twist, and in almost every case where it has been used, it has been found that the yarn lacked the necessary number of turns to the inch. The spinning overseer as a rule has little concern in the amount of power used in the engine room caused by the above numerous defects simply because it does not show in his own cost of production. Many spinning overseers have accomplished the prevention of slack yarn at the cost of extra coal, and wear of the spindles. In summing up the above, it must be said that no spinning overseer can operate a spinning room successfully without knowing the actual speed of his spindles. And from what we have said above, it should be seen that watching the number of turns that should be inserted in the yarn is just as important as it is

FOR THE CARDERS

to watch the number of turns that should be inserted in the roving. Some readers may take exceptions to the above, and perhaps say that the above is all theory, but let me say that the writer has experienced the above defects, and has had a chance to study them when many mills adopted the long bobbins. If the spindle is not responsible for most weak yarn, why was the long bobbin a failure? Among some of the reasons that were given at the time was the one that the drag of the filling in the shuttle was the cause. However, most

mill men know better, because they know that only one inch more of drag will not cause the amount of yarn breakage which was experienced at that time.

The writer, after weeks of study, found the cause to be in the extra load on the spindle. The longer the bobbin the more uneven it is in distribution of weight. It is not symmetrical and the centre of gravity is not in line with the axis. This retards the spindle and consequently the yarn is weakened. No. 126.

CXXVII. CLEAN TRAVELLERS.

The accumulation of fly on the traveller should be given much attention, because it quickly adds to the friction on the ring. Some writers advocate greasing the rings with a special grease when doubling. We have already explained the evil a greased ring will cause. When doubling, instead of greasing the rings after allowing the traveller to accumulate fly, adjust your traveller cleaner so that it will circle one-third of the traveller.

The traveller cleaner is only an upwardly projecting piece of metal, which removes the fly from the traveller if properly adjusted. Very few ring frames in operation are found with all the traveller cleaners properly adjusted. You will find some below the traveller, others knocked down and allowed to remain so, and some set too far away from the traveller. The best method to set a traveller cleaner is to obtain a very thin piece of paper, and then push the traveller outwards as far as it will go, then place the paper between the traveller and cleaner and set the cleaner up to that traveller, and tighten it there. If the fly still collects, or if running double, file the cleaner with a round file a little larger in diameter than the traveller, this will allow the cleaner to circle about one-third of the traveller. In setting the cleaner, take your time and your patience and labor will be well rewarded, because to have good spinning you must have a free traveller, and in order to have a clean traveller you must have the cleaner properly set at all times.

THE TRAVELLER CLEANER.

There are but very few spinners who don't understand the principle of the traveller cleaner. They know full well that a cleaner will not do its work when too far away from the ring, or if the cleaner does not project upward to the extent of one-eighth inch above the traveller, or if knocked out of position. Still, knowing the amount of friction that this neglect will cause, they advocate oiling the rings rather than taking the trouble of adjusting their traveller cleaners. Mr. Reader, if you are a mill man, take a walk into some spinning room and you soon will be convinced that there are few spinning rooms that have their traveller cleaners properly adjusted; in fact, in all my travels, I have seen only four spinning rooms where the traveller cleaners were properly set. It should be seen that the above neglect will create much friction besides injuring the rings, and that it is highly important to keep the traveller free from fly.

Another point we wish to give to the manufacturers is that traveller cleaners are useless when the length of the cotton used is below an inch.

STOCK GOVERNS FLY.

The above is also a good point for a spinner, because he can judge his stock by the amount of fly that accumulates on the traveller. You will always find in all mills where long staple cotton is used much fly on the travellers, and if the cleaner is not properly set, you will find that the cluster of fibres forms a tail. If the cleaner is properly set, you find many fibres wound around the traveller with their ends chopped off by the cleaner. On the other hand, if short stock is used, it is very seldom that fly will accumulate on the travellers, the amount being so small as to make the traveller cleaner useless. There are different types of traveller cleaners, some are fastened to the plate, while on others a lip is punched out of the plate ring holder, which pro-

jects high enough to catch the fly that may be carried by the traveller. It must be remembered that the top of the projected part must at least be even with the top of the ring, in order to receive any benefit from the cleaner. When cast-iron holders are used, the traveller cleaner consists of a bent piece of wire, sprung around the ring with one end bent upwards to project a little above the ring, and set to the thickness of writing paper to the traveller, when the latter is pushed to occupy an outward position as far as it will go. The position of this latter type is more liable to get out of order, owing to its position depending on the strength of the spring in the wire. No. 127.

CXXVIII. SEPARATORS WRONG.

The traveller makes a number of revolutions equal to the number of revolutions made by the bobbin less the number of revolutions required by the bobbin to take up the yarn delivered. Thus the traveller revolves around the ring several thousand revolutions per minute. We are told by writers of texts books, that, due to the yarn being held within a limited space between the thread guide and traveller, the loose yarn between these two points revolving around the ring at such a very high speed, tends to bulge out this loose portion of yarn at the centre, on account of centrifugal force, causing the yarn to balloon, as it is termed. Continuing, they tell us that the ballooning results in the yarn from one traveller striking against the yarn from the next traveller, causing entanglement and breakage of ends. Again, they say to have space enough to allow this loose yarn freedom would entail unnecessary expense in building so long a frame, as well as a waste of floor space; consequently, they advise us to use what is known as a separator to reduce the space between the spindles.

OPEN FOR CRITICISM.

The writer does not claim to be right always, and if wrong in criticising the above, the builders and manufacturers should not let the following pass unnoticed, as it will be evidence that what is said is true. Let us take the above statements apart and examine them.

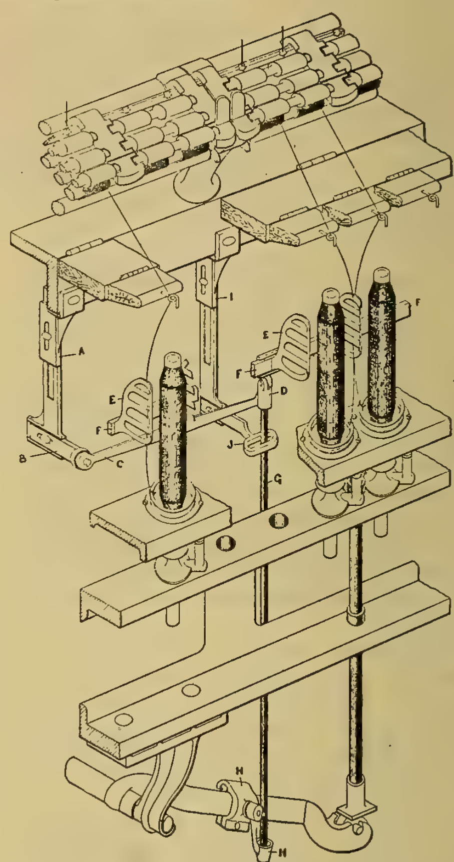


Fig. 41. Portion of Spinning Frame Equipped With Separators.

It is admitted that with the present gauge of ring-frame, the yarn from one traveller will strike the yarn from the next traveller if separators are not used to check the ballooning within certain limits. So by placing a separator between each end we are taking up still more space, and it must be admitted that more resistance is offered to the yarn revolving freely. The writer is willing to admit that the plates of which the separators consist are made very smooth, to avoid any unnecessary friction on the yarn.

But we have already explained that any pull on the yarn which is caused by the latter being struck would lift the traveller and cause the inside point of the traveller to wear the ring hollow at the point where the end is struck, which is twice every revolution, thus making what is termed a wavy ring. As regards the statement that building a frame with a gauge to allow the portion of yarn between the guide wire and traveller enough space to revolve freely would be unnecessary expense is very erroneous, and to the writer it seems misleading. By picturing in our mind a frame built with a gauge wide enough to allow this loose yarn freedom to revolve, it should be seen from what we have said that the path of the traveller would not be changed, and the rings would wear evenly instead of wavy. In such a case as referred to above, the ring would give many years of good service, because its surface would be smooth at all times, and no resistance would be offered to the traveller, thus saving the latter. As the writer sees it, the separators are ring and traveller destroyers. I would like to see a room equipped with ring-frames consisting of a wide enough gauge to allow the ballooning of the yarn freedom, and the expense saved in rings and travellers recorded. I am afraid that such a test would ostracize the separators, when such a record was compared with the expenses of a room equipped with separators. The cost of a wider gauge frame and an extra amount of floor space is not as great as writers would have us believe. If the reader has already paid ring and traveller bills, he will admit that the extra initial cost is not important.

No. 128.

CXXIX. SEPARATORS USELESS

Instead of being an unnecessary cost as claimed, it is an expense laid to advantage. Rings and travellers would be saved, and the runing of the work improved. We have proven elsewhere, that in order to have good spinning, the traveller must have freedom to revolve, as must also the loose portion of yarn between the guide wire and traveller. We all agree that the traveller revolves faster as the diameter of the bobbin becomes larger, for such has been the well-founded, and almost universally accepted theory for many years, which proves that the smaller the ring the faster the traveller revolves. Again, all practical spinners will admit that a large ring will wear much quicker than a small ring. Why is this so? As we see it, the faster the traveller revolves the quicker the ring should wear. Of course, it must be admitted here that there is less tension on the yarn when the ring is small, but it is not the tension itself that destroys the rings, because the tension only would wear the ring evenly. Rings in most cases, are not

TURNED OR CHANGED

because they are worn enough not to fit the traveller. It is the uneven wear that offers so much resistance and wears the traveller. So if the large rings wear sooner than the small rings, what is the cause? Surely, it is not the slight difference in tension, because, as stated, the ring would be worn even, and besides, we admit that the traveller revolves slightly faster when the ring is small. Then what wears the large rings sooner than the small rings? Here is where the writer proves that a wide gauged ring-frame will save a great amount of unnecessary expense besides turning off a better and larger production.

When a frame is running filling the space between the blades is not so limited, because the manufacturers as a rule demand a wide enough gauge so that the frame can be changed from warp to filling or vice versa. Now the chief reason for the uneven wearing of the larger rings is because the space between the separator blades is reduced, which causes the yarn to give the separator blades a harder blow, and thus, as we have proven elsewhere, the traveller is lifted correspondingly, and we have a

wavy ring. Again, the harder the yarn is made to hit the traveller, the more fly we have.

EXAMINE A FRAME

with small rings that has space enough so as not to hit the separator blades, and you will find a clean frame. On the other hand, when this space is too limited, you will find a large amount of fly, especially on the weights.

The above tends to make the face of the cloth harsh, because if the fly was allowed to follow the yarn, most of the fly found about the frame would serve in making the face of the cloth smooth. From what we have said above, it should be seen that having no separators and a gauge wide enough to give the free portion of the yarn freedom to revolve, a higher speed and better spinning could be attained. So if the above is true, the advantages that would result from spinning frames built with a wider gauge, should clearly be seen by the reader:
1. We save travellers and rings.
2. We allow the fly to follow the thread, which improves the face of the cloth, and at the same time it gives the room a cleaner appearance.
3. By giving the yarn and traveller freedom, we can run at a higher speed, thus increasing the production.
4. The initial

COST OF PURCHASING

separators is removed. To the writer, the separators do not only appear useless, but as stated they create much unnecessary expense. All the above points have been obtained by years of practical experience, and the writer knows that many practical spinners will enjoy reading the above facts, because they themselves have had such experience.

All practical spinners agree that separators are an evil, and besides being expensive and injurious to the strand, they are in the way. They catch much dirt and waste that is distributed on the bobbins when the least draft is created in cleaning the frame.

They also interfere with the full view of the bobbins when looking to see if the traverse is even and the bobbins on the frame all one height. They are an obstruction in removing the bobbins, and many spinners have experienced bad cuts on pulling off the bobbins. However, on high speeded narrow-gauged frames, they are necessary, but why install a narrow-gauged frame and leave a large spare floor as found in the majority of our mills? They tell us that spare floors are a comfort to the help, but if the spare floors in mills where they are found were reduced and large spaced frames installed without separators, it would be found that the help, and also the mill, would be more benefited.

No. 129.

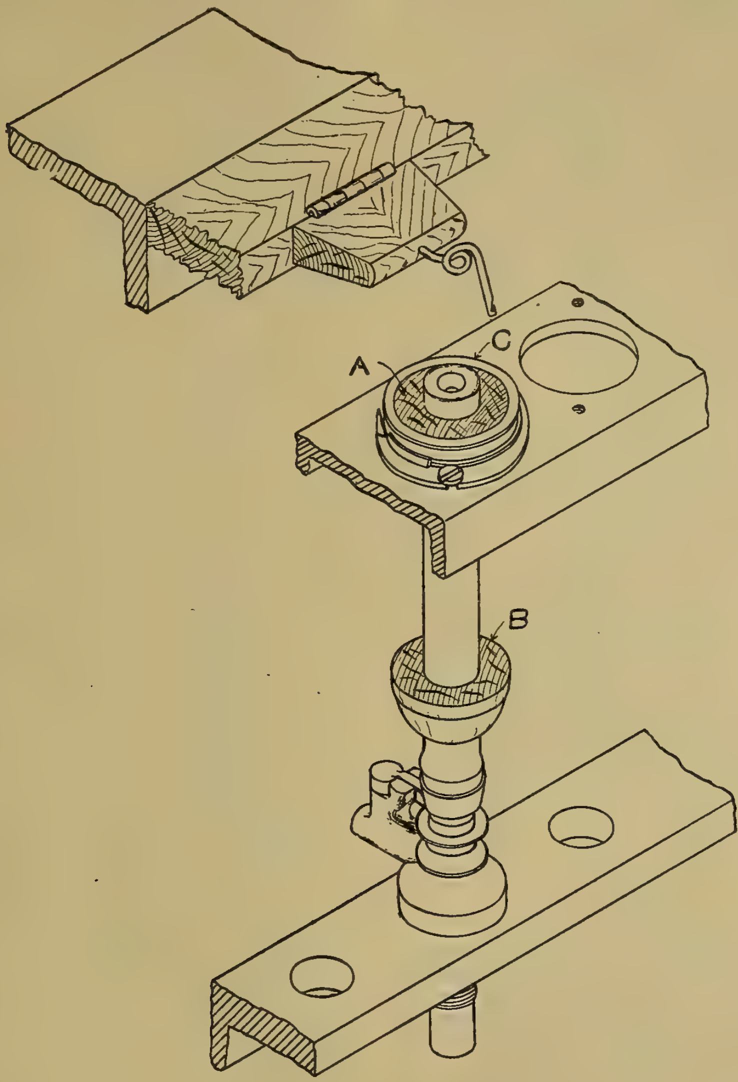
CXXX. LIFTER RODS.

The lifter rods are an important consideration, and they are the most neglected part of the frame. The writer has often entered a spinning room and found the lifter rod in such a condition, that the end of the ring rail could be swung laterally one-eighth of an inch, and in some cases three-sixteenths of an inch.

To prove what harm a worn lifting rod will do to the ends, find a worn lifting rod by feeling of the ends, on the end of the ring rail. If much vibration is felt on the finger, continue to hold the finger on the end and with the other hand push or pull the ring rail, so that the spindle will be in the centre of the ring. You will note the difference easily, and the extra amount of vibration that the above defect creates will be realized. No mill man need be told that the spindles should be set in the centre of the ring, as they spend many dollars yearly for setting the spindles. But in many cases, setting spindles is a step in the wrong direction, because it is too often true when spindles are set, that the lifting rods or bushings should have been changed instead.

Lifter rods should be examined and oiled often, and if too much play is found, a new bushing or rod should take the place of the old. On some

frames, in order to prevent the accumulation of fly and dirt on the lifting rods, which causes them to bind, a stead of preventing dirt and fly from collecting, it allows more to collect than when the rod is exposed, owing



METHOD OF SETTING
SPINDLE TO RING
Fig. 40A.

casing that extends

THE ENTIRE DISTANCE

between the spindle and arch rails is provided, but it must be said that instead of preventing dirt and fly from collecting, it allows more to collect than when the rod is exposed, owing to the fly and dirt collecting inside the casing which thus binds the rod.

The best type of lifter rods are those that are held in place by two

vertical sections, which form the bushing, for the simple reason that if a slight binding is noticed, it is possible to remove and clean them while the frame is in motion.

Another defect in connection with lifting rods is in the step in which the lifter rod rests. On almost all makes of frames, there is not enough body around the recess of the step, so that when the step is removed and replaced again, when it is tightened, it too often happens that the recess bursts. The best method in keeping the lifter rods clean is to bend a wire so that each end will closely fit the lifter rod, and have each end covered

WITH BRAIDED CORD.

Have one end of the wire on top of the bushing through which the lifter rod passes, and the other end under the bushing. It can be seen that, with such an arrangement, the wire and bushing can be quickly removed. Again, if fly or dirt accumulates under the braided cord, the pressure of the wire will give way and the dirt collected will fall to the floor. Lifter rods often give trouble, owing to their not being in a perfect vertical position, and for this reason, a level should be placed along side of the rod, and if it is found to be in a perfect vertical position, the bushing should be changed at once. No. 130.

CXXXI. BOBBIN SLIPPING.

Bobbins raising up on the spinning frame spindles is a defect misunderstood. Many spinners are to blame for such conditions through their own carelessness, especially when ordering new bobbins. When bobbins are continually raising on the spindles, the cause should be located, because it is an evil that is more detrimental to the twist per inch and poor warping than any other. Very few ring spinners understand the principle of a bobbin, and for this reason, they accept conditions as they find them, and struggle along with misfit bobbins. The best method of locating the cause is to split a bobbin and then lay the spindle blade with cone on the whorl on one section of the bobbin; the cause can then be easily seen. But as stated, it is necessary for the spinner to understand the principle of the bobbin. The bobbins should be made so that the bases will set snugly in the brass cap which aids in positioning it, and the cone on the whorl, but it must fit the cone snugly at all times. Figure 42 shows the section of a split bobbin on the spindle. A is the cone, B the spindle blade, C the recess for the reception of the spindle blade. The brass cup is not shown for the reason that it is well understood by the mill men.

The bobbin, as stated, should fit the cone A snugly, in order to

DRIVE THE BOBBIN.

C, the recess or hole, should fit the spindle without friction. Thus it will be seen that the bobbin should be driven at the base, and not at the point of the spindle. It should be seen that if the bobbin does not fit the cone snugly, the former must be driven by the spindle point, which creates much vibration, and finally works the bobbins up on the spindles. Some overseers misunderstand the different parts of a spindle, and for this reason, the brass cups on the cone of the spindles have found their way to the scrap heap. Brass cups do aid in positioning the spindle, and if the bottom inside of the bobbin does fit the cone snugly the bobbin will be driven by the cup instead of the point of the spindle. Thus the bobbin is always driven at the base, and the liability of vibration is not as great. We hear much about band slipping from different writers, but bobbin slipping is never considered, and it does affect the twist per inch more than band slippage. Imagine a bobbin loose on the blade of the spindle dragging the traveler, especially on a heavy day. Think how the turns to the inch are affected, and the amount of slack twisted yarn that is made.

Again, imagine how that one end will continually break and stop the warper. I think the reader will admit that bobbin slipping is the chief evil

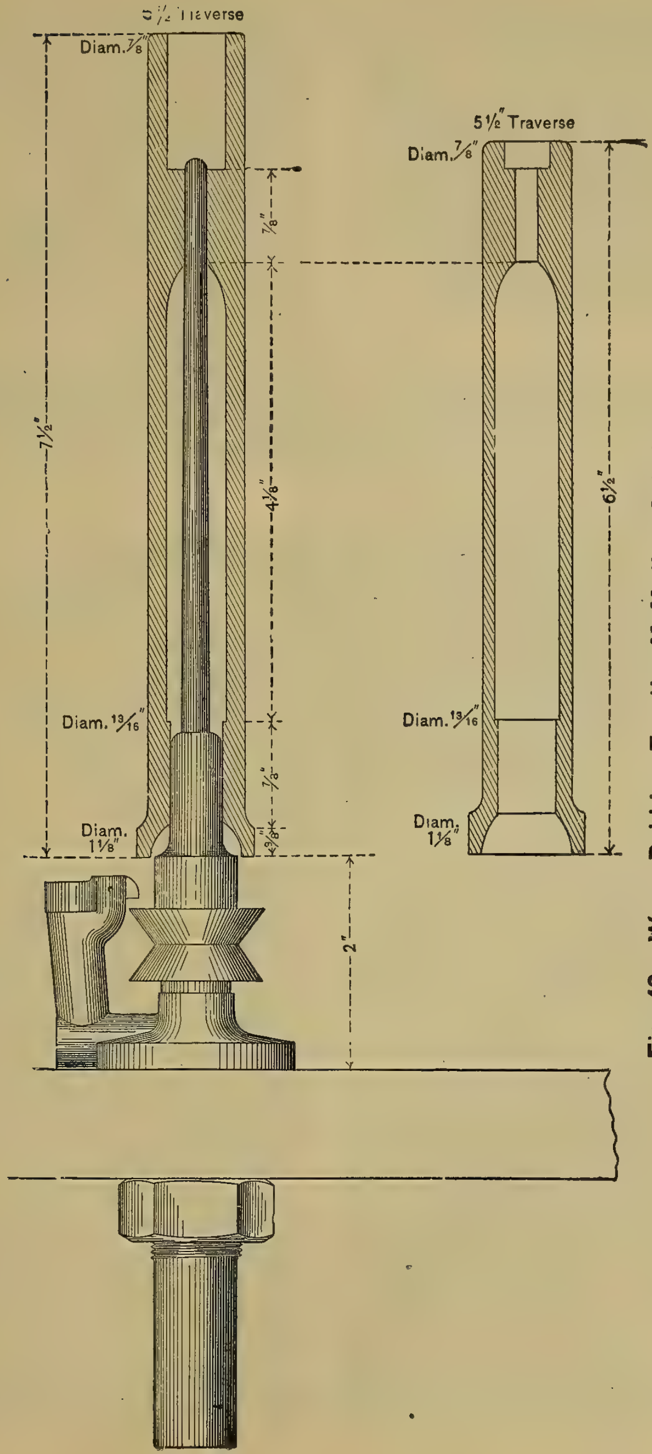


Fig. 42. Warp Bobbins For the McMullan Spindle.

of poor warping. It must not be forgotten that it is the revolving of the bobbin that exerts the pull on the yarn necessary to set the traveler in motion.

When ordering bobbins, a spindle should be sent to the bobbin maker, and at the same time, he should be given the above instructions. If manufacturers realized how much misfit bobbins cost them in running their mills, probably they would wake up. Bobbin slipping has often been the cause of a cramped cylinder.

No. 131.

CXXXII. BANDING.

The cylinder of a ring frame is composed of very heavy tin, and is made in sections mounted on a shaft. For this reason, the bands should have as near as possible the same tension. When banding a cylinder, in order not to cramp it, tie a band on one side, then tie a band on the opposite side, and from side to side until it is all banded. Remember this, never tie a band on a cylinder when it is stopped, because it is impossible to obtain the proper tension, besides much damage may be done, even at times causing fire. Always band a cylinder when running, and the spinner will be well rewarded in the good running of his room if he will spend a little time with the band boy and teach him the skill of having as nearly as possible the same tension on each band. The spinner should watch the diameter of his bands always; never neglect this, because different sized bands give different speeds, which

AFFECT THE TWIST

per inch. This will be proven when the twist is calculated. The layers on a warp bobbin extend nearly the entire length of the bobbin, each succeeding layer being a little shorter than the preceding one, which gives to the full bobbin a taper at both ends. Before the mechanism adapted to produce these results is explained, it is necessary to understand how a different weight of traveler will affect the amount of coils possible to be placed on a bobbin. The above is one of the most important points in ring spinning, and also a costly one. Many writers will tell us to have the coils closer to the inch in order to prolong doffing time. Such a statement is very erroneous and misleading, because it is based on the fly frame principle, in which the coils to the inch do affect the compactness of the bobbin. But on a ring frame, the secret lies in a heavy traveler, whether you have 50 or 100 coils to the inch. The traveler is to the surface of a ring frame bobbin as it rotates, what the heavy presser rod and finger are to the surface of a speeder bobbin as it revolves; that is, the heavier the traveler, the more continuous pressure is exerted on the preceding layers, thus laying each layer closer and making a more compact bobbin. This should be

THE CHIEF AIM

of all spinners; that is, to always run a heavy traveler, because (1) you are able to put much more yarn on the bobbin, which reduces the cost of the spinning, and it reduces the number of doffs, which increases the production; (2) you will have less whipping, which prolongs the life of the ring and traveler, besides less fly is made and you have a cleaner room; (3) the cost of spooling is greatly reduced, because when you make a compact bobbin you weigh yarn instead of wood in the spooler box. The writer has seen cases where 3,000 pounds more production was put through without disturbing the cost in the spooling room; (4) when you run a heavy traveler on your frame it is a telltale to defects in the spinning. For instance, let us suppose that the yarn lacks the necessary number of turns to the inch, or that it has weak places, etc. Is it not much better to have the traveler break the yarn than to have this defective yarn run through other processes, and make trouble and waste? As stated elsewhere, many mill managers force the spinner to take out twist, and he does so, but finds that the yarn will not stand the pull exerted by the traveler, so he puts on a number lighter traveler to

REMEDY THE SPINNING,

which, of course, is the only thing

to do, but what about the following processes? The above is responsible for the deplorable conditions found in all mills where the yarn lacks the proper number of turns to the inch. When the yarn is weak, the spooler guides must be opened to ease up on it, thus allowing large piecings and bunches to pass beyond their action. On the warper the ends are continually breaking, causing more piecing, and increasing the hitch backs on the slasher. On the slasher the amount of gum in the sizing must be reduced, owing to the weak ends following the slasher cylinder. In the weaving, we have more hitch backs. The yarn continally breaks, which again causes more piecings, and the result is that a much larger percentage of cloth is put into seconds.

All experienced mill men know that the above is true, and that at this very writing there are mills running where the correct number of turns to the inch are not used. In most cases, you will find that the superintendent is to blame. In a spinning room the conditions are much different from those in the card room. When the proper amount of twist is inserted to carry

A PROPER TRAVELER,

let such conditions alone through summer and winter, unless the grade of cotton is changed, when, of course, the frame must be changed accordingly.

Taking out twist for the winter in a ring spinning room, when the same grade of cotton is used, is the basis for fault-finding from the mill office. As stated, when the front roll is speeded, a lighter traveler must be used to help the weak yarn. This increases the production for a few months in the spinning, then when the same amount of twist is again inserted in the yarn and the speed of the front roll reduced, a reason is demanded from the office for the falling off of production. Besides, as was explained, when using a lighter traveler, the bobbins are not so compact, and the proportion of wood in each bobbin is increased, which increases the cost in the spooling room. To most overseers of spinning and spooling, the above is hard to explain. because very few overseers of spinning ever even consider the amount of difference a tooth of twist will make in after processes, both in running and cost. No spinner deserves any credit for speeding up a front roll by changing the twist, as any ordinary fixer can do that.

Credit is due to the spinner who can judge the stock and change the twist to advantage, and at the same time in-

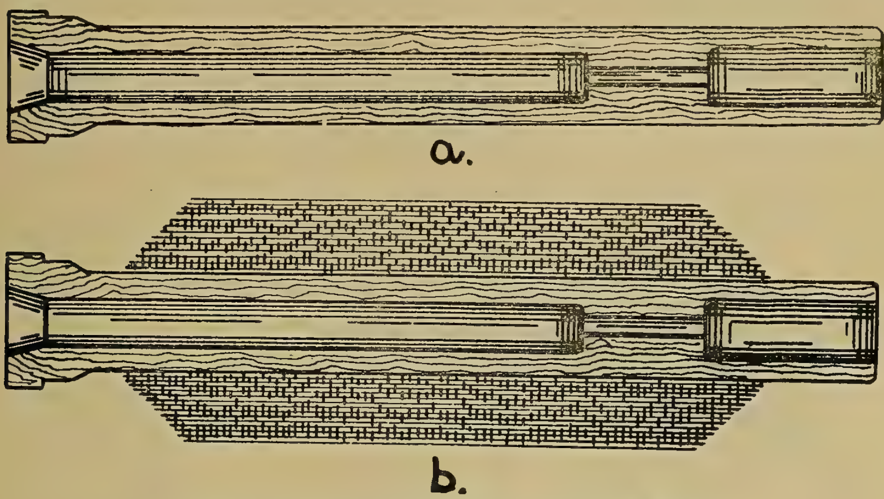


Fig. 43. Section Through Warp Wind Bobbin.

crease the production and make conditions better in after processes. Then an explanation for the

INCREASED PRODUCTION

can be given—better stock. A great mistake is made by many overseers in conceiving the idea that very few mill managers understand the structure and peculiarity of the cotton fibre. This is very erroneous, and the man that conceives such an idea is standing on dangerous ground. The writer has had the pleasure of discussing the subject of cotton grading with many of these gentlemen and has found in each case that they understand and know what can be done with a certain grade of cotton. Some can even tell you the average tensile strength of the fibres before and after running, and they also know the number of grains at which a poor or good single fibre should break. No. 132.

CXXXIII. RING SPINNING.

Figure 43 shows a section through a warp wind full bobbin. By the taper on each end of the bobbin it can be seen that the first layer extends almost the entire length of the traverse on the bobbin, and the next succeeding layers are a little shorter than the preceding ones. Figure 44 shows the mechanism that indirectly guides the coils on the traverse of the bobbin, and forms the taper at each end. The arm, A, is fulcrumed at the point, A1, and carries a cam-bowl, A2, that is operated by contact with cam Y.

As the cam, Y, revolves, arm, A, is free to move to the extent of the shape of the cam. The chain, B, is connected at the point, A3, to a rack, A4, by means of a hook that passes over a pulley, B1, and the other end is connected to a quadrant, B2, by an eye bolt and two nuts, which serves as a check, Figure 45.

The

QUADRANT IS ATTACHED

to an upright arm, B3, which is connected to a rod, B4, that is supported by a bracket, C3. The rod, B4, runs transversely across the frame, and bracket, C3, is bolted to the rail, C2. Connected to the rod, B4, is a horizontal arm, T3, which supports the lifter rod, T. Another arm, B5, carrying the weight, B6, is also connected to rod, B4. It can be seen with such an arrangement that the weight, B6, has always a tendency to swing the upright arm, B3, to the right. As the ring rails are supported by the lifter rods when they make their up-and-down movement, the ring rail will move with them and give a traverse

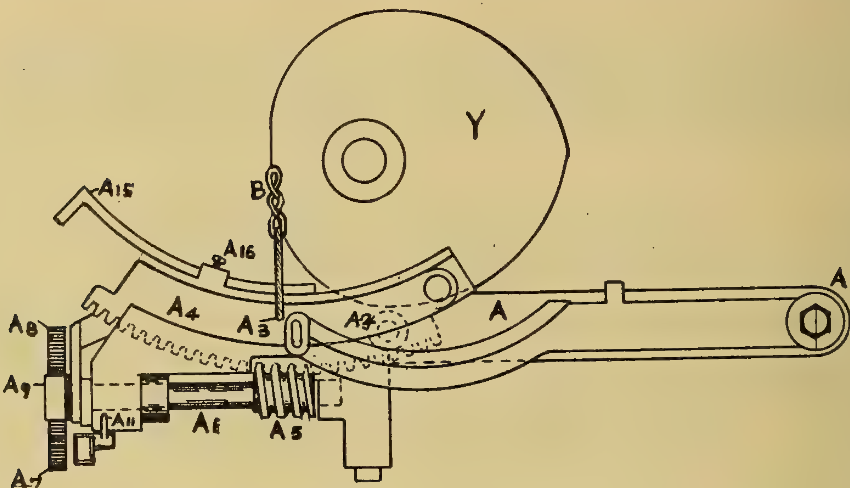


Fig. 44. Diagram of Combination Builder Motion.

to the coils of yarn as they are laid on the bobbins. By referring to Figure 44, it can be seen that as the cam, Y, revolves, it forces the arm, A, down until the cam-bowl has reached nearest the centre of the cam. When the cam-bowl is nearest the centre of the cam, the arm, A, is then allowed to rise through the action of its own weight. Motion is imparted to the ring rail by the chain, B, and its connections. When arm, A, is forced down, it takes the chain, B, with it, and as it is attached to the quadrant, sufficiently heavy to over-balance the weight of the ring rail, which forces the lifter rods and ring rail up, and an up-and-down traverse of the yarn on the bobbin is obtained. As stated, the chain, B, is connected to the rack, A4, which is supported in grooves cast in the arm, A. A4 has teeth on its lower side in which the worm, A5, works, the worm receiving motion from shaft, A6, through a ratchet gear, A7, on the end of shaft, A6, and pawl, A8. A8 is mounted on an arm, A10, which is

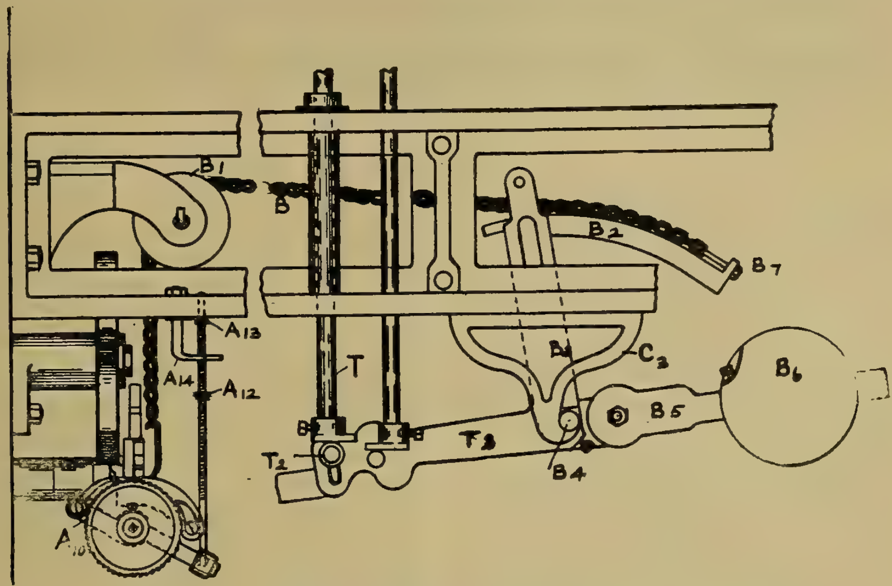


Fig. 45. Diagram of Combination Builder Mot on.

it acts upon it and will swing the arm, B3, to the left and turn the rod, B4, thus lifting the weight, B6.

When the weight is raised, it allows the lifter rod to drop, owing to the weight of the ring rail and its connecting parts. Thus, it can be seen that by this action

THE RING RAIL

is moved from the top to the bottom of the bobbin.

When the chain is slackened by the action of the cam, which is caused by the cam-bowl being nearest the centre of the cam, the weight is made also supported by shaft, A6, and works into the teeth of the ratchet gear, A7. The other end of A10 is connected to a threaded rod, A11, which carries two set-nuts, A12 and A13, plainly shown in the figure. It can be seen in the figure that the rod, A11, passes through the casting, A14, which is bolted to the rail, C2. A15 serves to regulate the distance to which the rack, A4, may be moved to the left, and it can be placed in any desired position. The arm, A, is moved to the left as far as A15, as the first layer of yarn is placed on the bobbin. This brings the chain, B, as far from the fulcrum point of

arm, A, as it can go, and thus the greatest traverse is obtained. Each downward movement brings the nut, A13, against the casting, A14, which prevents the rod from moving any farther in its

DOWNWARD DIRECTION.

Thus it can be seen that this will cause the pawl, A8, to turn the ratchet gear, A7, a certain number of teeth, the number being regulated by the position of the nuts, A12 and A13, to accommmodate any counts of yarn. If the different parts in the figure are followed, it can be seen that when the ratchet gear, A7, is turned, motion is imparted to the shaft, A6, which carries the worm, A5. So when shaft, A6, revolves a part revolution, the worm, A5, engages the teeth on the lower side of rack, A4, and causes it to move to the right, and the traverse is slightly shortened. When the weight forces the lifter rods up, and the quadrant is brought to its former position, the rod, A11, is raised by the arm, A, bringing the other pair of set-nuts, A12, in contact with the casting, A14, which moves the pawl, A8, back to the right, and thus it is brought again in its correct position to engage with the teeth of the rachet gear on the next downward motion of arm A. It will be noticed that there is another pawl, A9, which is simply a stop pawl, to hold the ratchet gear in its position as the other pawl is moved to the right.

Figure 46 shows a section of a full filling bobbin. It can be seen that the build of the bobbin differs to a large extent from that of the warp bobbin. The filling wind instead of having layers extending from one end of the bobbin to the other, only extends a short distance, and the traverse is moved slightly higher every succeeding layer. Thus it can be seen that the length of the traverse is not changed. Each succeeding layer is moved slightly higher, and the same distance.

The tapered part of a filling bobbin is called the chase, the point being called the nose and the bottom of the traverse the shoulder. There is much argument among mill men about the manner in which the rail should be driven. As is well known by most mill men, the ring rail travels much faster in one direction than in the other. The reason for running the ring rail faster one way is to stop the yarn from being pulled off in bunches at the loom, which is termed slubbing off at the nose.

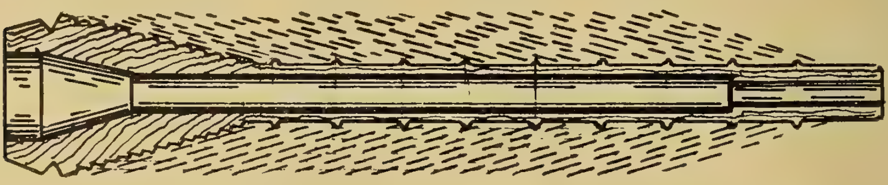


Fig. 46· Section Through Filling Bobbin Wound With Yarn.

When the ring rail is made to travel slowly in one direction, the coils are laid closer together; then if it is given a quick motion when traveling in the other direction, the coils will traverse the preceding coils and will tend to hold the yarn together. When the rail is making its slowest movement while going up, it is called binding from the nose to the shoulder.

If it travels slowly when moving down, it is called binding from the shoulder to the nose. Each method above described is adopted on ring frames, and you will find mill men that claim advantages in both methods. Now, which is the better method?

No. 133.

CXXXIV. SPINNING SUGGESTIONS.

Let us consider what happens when we do the binding from the shoulder to the nose, or in other words, when the ring rail moving up has its quickest motion. Let us assume that the ring rail is moving down with its slow-

est motion, and the coils are laid closer, until the rail has completed its traverse and the direction of the rail is changed. It will be found that, as soon as the ring rail starts to move up, its quick motion will cause the yarn to balloon slightly. From what we have already said about the tension and traveler, it should be seen that the tension must be somewhat relieved to cause ballooning. As we see it, the above method should be favored, because when the rail is making its quickest motion when moving up, it is moving in the opposite direction to the ring rail is moving up when having its slowest motion and the coils are laid closer until the rail has completed its traverse, and its direction is changed. It must be admitted here that if the sudden change of direction and speed of the rail will cause the yarn to balloon when the rail changes on the bottom of the traverse to make its quick upward movement, the tension will be affected correspondingly when the rail changes on the top of the traverse to make its quick downward movement. From the above, it can be seen that the ring rail is mak-

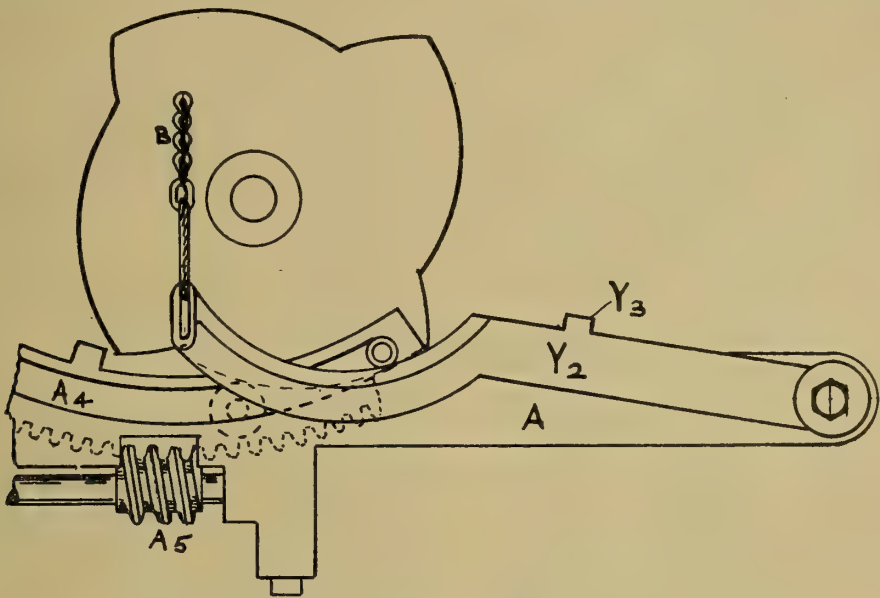


Fig. 47. Builder Motion Showing Filling-wind Cam.

delivery of the yarn, which causes the latter to balloon slightly. In the above method, the only objection is that the yarn may whip, which can be remedied by the properly weighted traveler. On the other hand, let us assume that we are binding from the nose to the shoulder, or the ring rail having its slowest motion when moving up, and its quickest motion when moving down.

It should be easily seen that the movement of the ring rail will have the opposite effect upon the yarn in the latter method. So let us consider in this case as we did in the last that the ing its quickest movement in the same direction of the yarn, which, of course, has more tendency to

PULL THE YARN

from the front rolls. Again, from what we have said, it should be seen that this slight increase of the tension will cause the traveler to dig into the surface of the ring at every downward change of the traverse, thus wearing the rings and travelers. If the reader is a mill man, he should clearly realize from the above that the binding from the shoulder to the

nose is best, because it not only helps the running of the work, but also saves the wearing of the rings and travelers, which is quite an expensive item.

All up-to-date ring spinning frames are, as a rule, equipped with what is known as a compound builder. Such a builder is shown in Figures 44 and 45, (see our issue of March 9), and when changing from a warp wind to a filling wind the warp cam, Y, which is known as the warp cam, is replaced by the filling cam Y1, Figure 47. By referring to Figure 44, it can be seen that the chain, B, is connected to the rack, A4, while in Figure 47 it is connected to the arm, Y2, which has no function to perform when the warp cam is used, and is supported by the arm, A, by means of a projection, Y3, which extends laterally over arm, A.

The chain, B, must be shortened when using the filling-wind cam, because the arm, Y2, must be raised until it comes in contact with the stud, Y4, on the rack, A4. The chain, B, is shortened by the nuts, B7, Figure 45.

It must be understood here that there are various types of combination builders, but they are all constructed on the above principle. On some types of builders, the arm that carries the cam-bowl or Whitman roll, as it is known, is changed to the other side of the builder. This arm

IS SO CONSTRUCTED

that it has a reception for the roll or cam-bowl on either side, and the cams are so placed that when this arm is turned it will come directly under each cam, so that the roll will engage the full width of the face on the cam.

Again, a special hook must be used when the chain is connected to rack, A4, and instead of an eye for the reception of the hook on the chain, B, on the end of the arm, Y2, the end of the arm is hook-shaped. From what we have said, it should be seen that the revolving of each cam alternately forces the arm, A, down and allows it to be raised in both systems by means of weights. We will now explain the change in position of each coil of yarn on the bobbin, which in the filling-wind is obtained in a different manner than the varying position of the coils in a warp-wind.

By referring to Figure 45, it will be seen that the action of the pawl is exactly the same in both systems, and that the downward motion of the arm, A, causes the pawl to act on the ratchet gear, A7, and thus the ratchet gear is turned a certain number of teeth. We have explained elsewhere that every movement of the ratchet gear acted correspondingly on the worm, A5, which is given a part revolution, and forces the rack, A4, to the right in both systems. We now refer to Figure 47, and as was stated before, the arm, Y2, must be brought into contact with the stud, Y4, that is carried by the rack, A4. As the bobbin fills, the point of contact between the stud and the arm, Y2, will be moved to the right together with the rack, A4. Owing to the shape of the face of the arm, Y2, and also the groove in which the rack, A4, slides, the arm, Y2, is made to occupy a higher position, due to the weight, B6, forcing up

THE LIFTER RODS

which slackens the chain as in the warp-wind. One point that should be noticed here is that the arm, Y2, bears the same relation to the fulcrum, A1, of this arm during the entire building of the bobbin, and that each succeeding layer is made to occupy a higher position on the bobbin by the point at which the chain, B, is connected to the arm, Y2, being raised at each succeeding downward movement of the ring rail.

The chain should be connected exactly in the centre of the rack, so as to have the same amount of working on each side of the rack. This is a point much neglected in many mills, especially in mills where the length of the traverse is changed often. It is often that a change will bring the connecting point in some cases as far as two inches from the centre of the rack. When the chain occupies such a position, it is impossible to produce a perfectly built bobbin. We have

said that in both methods the rack was moved to the right until the bobbin was filled. So it follows that the rack must be moved to the left before a new set can be started. By referring to Figure 45, it can be seen that the hole in the centre of the ratchet gear is square-shaped. This is for the reception of a handle that fits the centre of the ratchet gear, and by turning the gear and its connections, the rack, A4, is moved to its correct position, and the different parts will also be in position to place the first layer of yarn on the bobbins. As stated, there are various types of builders, single and compound, and each maker claims some advantages, but it must be said that there is very little difference in all types except that some are more simple than others in construction. Again, there are so many different methods of effecting the construction of the bobbin and regulating the length of the traverse, that it is almost impossible to explain each one. No. 134.

CXXXV. FRAME FIXING.

Some fixers will change the position of the rack to affect the shape of the bobbin, while others will change the position of the bearing supporting chain pulley, B1, others will lengthen the traverse by the chain, B, while some will change the position of the quadrant. The chain should be examined often, also the position of the take-up nuts, B7, because the frames are run so long in some mills that the points of the chain become worn to such an extent that even the take-up nuts will not take up the amount of wear when they are turned as far as they can go. The set nuts themselves are liable to get loose and work their way to the end of the small threaded rod, which often happens, owing to the vibration of the mill. When the chain is too long, the coils are made to occupy a different position on the bobbin, which causes much dissatisfaction, especially in the weave room. When the first coils are laid too high up on a filling-wind bobbon, it should be seen that the ring frame will be doffed oftener, and the amount of yarn on the bobbin will be much less, and a shorter length of cloth will be woven. Besides, the bobbins run empty sooner, which causes more shuttle changing. All mill managers will agree that when you increase shuttle changing you affect the quality of the cloth. It only takes a visit to some of our spinning rooms to see how the positioning of the yarn on the bobbins is neglected. The writer has seen the first coils so high up on the bobbin that they measured 1¼ inches from the first coil laid to the bottom of the bobbin.

Examine your filling bobbins in your weave room and you will find that the majority of the bobbins are not filled as they should be. Why are such conditions allowed to go on?

If a lot of expense was necessary to remedy the above defect, it could be offered as an excuse, but from what we have said about the builder, it should be seen that even if the manager refused to buy new chains, the chains could at least be shortened by cutting out one or more links so that the positioning of the first coils would come under the influence of the set nuts. It should be seen that in all mills where this defect is found it must be laid to lax methods, and it should not be tolerated

IN ANY COTTON MILL.

The writer has found the above defect in almost every cotton mill he has visited, and it does seem a pity that a waste of money should be allowed to continue, which also causes much discomfort among the operatives. I recently called on a man whom I knew to be a spinner of much ability. I noticed that his bobbins were not properly filled, the majority of them had no yarn on more than half the large end of the cone on the bottom of the bobbin. When I called his attention to it he made the following reply, which is instructive as well as interesting. It must be admitted that he gave us a good point. Now, whether or not he was careless, and when the question was put to him this ingenious thought stole into his mind I do not know, but I do know that he

gave us a good idea that will in the future change the construction of the filling bobbins when the separators are not used. His answer was: "You see, when I allow the ring rail to travel until it reaches the bottom of the bobbin, the cone being then so large it decreases the tension or pull so suddenly that the yarn will whip, and if I put on a heavier traveler to suit the tension when the rail is at its lowest position, it will almost pull the majority of ends from the rolls when it occupies its uppermost position. So, by using only a small portion of the cone on the bobbin, the tension is more equally divided throughout the travel of the rail".

From the above, it must be admitted that using a filling-wind bobbin with a cone at its lower end is a mistake, because a coneless filling bobbin will not only equalize the tension but it will also build a much better bobbin. If the reader is a spinner he can very quickly try the above by cutting the cone off one bobbin, and run this bobbin for a set on one spindle. The result will be surprising. No. 135.

CXXXVI. FAULTY BOBBINS.

Faulty bobbins may be caused in various ways. When a band is slack, it not only makes the bobbin faulty in appearance, but the yarn does not have the required amount of twist. Such a bobbin is only noticed here and there about the room, and it must be said that, with the present system of handling, slack bands will never be entirely eliminated. Faulty bobbins, which do not have the proper taper and which are not properly filled, are the cause of much unnecessary expense.

A long taper on the bobbin decreases the length of yarn that can be put on the bobbin, and this requires the frame to be doffed more frequently, which increases the per cent of stoppages, besides the cost in the spooling room is much greater. For this reason, a short taper for warp yarn is better than a long one. A long tapered bobbin is the same as a light traveler, a certain amount of yarn is lost in the winding in either case. The American Wool and Cotton Reporter has often pointed out this unnecessary expense, and it has no doubt helped many mills by so doing.

SPRUNG RING RAILS,

dirty lifting rods or bobbins not fitting on the spindle sleeve properly will cause a bobbin to have uneven surfaces. On the filling frames the bobbins should be reamed out at the top. The reason for this is that when the filling is moistened or steamed, the wood of which the bobbin is generally composed expands and contracts. As stated, bobbins should be tried on the reamer before they are again filled with yarn. When building a filling bobbin, it should be understood that the taper cannot be varied to a large extent. A change in the take-up of the builder does not affect the taper the same, but merely changes the diameter of the bobbin. No. 136.

CXXXVII. STANDARD EQUIPMENT.

There are several methods of driving the cam from the head. Some are driven by means of a chain and sprocket gears, others have an upright shaft, while others have connecting gearing using no chain or upright shaft. There is much argument about the superiority of each method, but the fact remains that there is very little difference in the movements of the rail in either one.

It is admitted by most all practical spinners that the chain drive works the easiest, besides each link is fitted so snugly that there is no play in the chain and there is very little dwell on the turning point of the cam. On the other hand, when gearing is used, there is more chance for back lash, owing to the large amount of gears meshing into one another. There is also some back lash when an upright shaft is employed, but not as much as when all gearing is used. However, although the above is true, the difference is so slight that it should not alter one's mind in the selection of a certain make of ring frame. After selecting the frame great care should be taken in making out the specifica-

tions for the building of it. This is the most common mistake made when

EQUIPPING A MILL.

One good point in equipping a mill is to have a few frames with their parts proportioned so as to be able to change them on either warp or filling and thus balance the production. Too often we find many cotton mills where they are flooded with filling yarn and are unable to change over, owing to the gauge of the frame being too narrow. Take your time when making out specifications and consider the proportion of all parts according to whether they are to spin warp or filling. The number of yarn intended for both warp and filling must also be considered, whether fine, medium or coarse. The space is the most important consideration, for it is here the manufacturer must make up his mind whether he will equip his frames with or without separators.

From what we have said about the amount of evil that separators cause, even if the manufacturer does favor separators, it should be clear that a wide gauge is a benefit, if only the pulling off of the bobbin by the spinner is considered. There are many who will say that they cannot see by examining the traveler while it is dragged around by the yarn how it can be affected by the

YARN WHIPPING,

because they will say that there are many that do not even touch the separator blades. This is one great fault the writer has always found to exist in all cotton mills; that is, the workers never learn how to think. It should be clearly seen that what was said about the evils caused by separators should not be applied to a case where the yarn is free to revolve between the blades. Again, some manufacturers claim that the blow of the yarn is so slight upon the blades that they fail to see how it is possible for it to injure the traveler or ring.

Then, let me ask, what is wearing your rings wavy? We know that the blow is not like the whip to a horse, but it is the number of times per second, minutes, hours, days, weeks, months and even years that count. Another point that is little understood by most mill men is the amount of freedom to the revolving end a slight increase of the space will give. One-eighth inch will give

SURPRISING RESULTS.

Space means the distance between the centres of two consecutive spindles, and is usually found to be 2⅝ inches.

Filling yarns are much weaker than warp yarns, owing to the difference in the number of turns to the inch inserted, and the filling yarn is unable to stand any excessive traveler pull that exists when the ring is large. For this reason, the filling frames are equipped with 1½ inch ring and the warp usually with 1⅝ inch. A good rule to follow is to have the largest ring diameter about one inch less than the gauge of the frame, and it will be found that there will be very little trouble with the travelers and rings. It must be understood here that most any reasonable size of ring can be furnished by the builders, which, of course, affects the gauge correspondingly. The diameters of rings most commonly used vary from 1½ to two inches. **No. 137**

CXXXVIII. LENGTH OF TRAVERSE

Another important consideration in making out specifications for the builder is the length of the traverse. Fine yarn should have a shorter traverse than coarse yarn. Another point that is much overlooked is the diameter of the cylinder. Some mill men, in order to have the same sized pulleys throughout the room, have a smaller diameter cylinder on the frames spinning coarse and filling yarns. They claim that the spindle speed should be higher when spinning fine yarns, and that the warp spindle should be higher speeded than that making filling. Although the above is true, it is much better to have the cylinders all one size, and have different sized pulleys to give the necessary speeds

WHEN MAKING CHANGES,

because it is much easier to change pulleys than to change cylinders.

Another important consideration when making out the specifications is the distance from bay to bay. This is a duty that falls into the province of both the administrative and constructive work. Mistakes have often occurred, and in some cases the machinery has had to be altered. When building a mill, the size of all machines should be determined and the distance between the bays gauged accordingly. The writer has recently visited a new mill that has a distance of 11½ feet between the bays, and the machinery was so well laid out to save walking for the operatives that the writer is glad to recommend the above distance. As a rule, a spinner is paid by the number of spindles she runs, and for this reason all ring-frames in certain mills are generally built of one length.

We have repeatedly said that it is impossible to learn the practical part from a book, because we know that the practical part is obtained only by every-day practice in the handling of tools and diligent study. However, we offer the following method of setting the spindle to the ring: The bobbin consists of two bosses, A and B. The first thing to do in setting spindles is to lower the rail so that the ring, C, on the rail, will be just even with the lower boss, B, and then adjust the spindle concentric with the ring. Next run the rail up so that the ring, C, will be even with the top of the upper boss, and again adjust the spindle concentric with the ring. When the spindle is not

CONCENTRIC WITH THE RING,

the best method is to shim under base of spindle to throw spindle one-half of the distance required, to make the spindle concentric to the ring. The quickest method and one used in most cotton mills is that of placing a piece of paper under the side of the casing. In setting spindles, the rail should be run up and down often, in order to average the lower and upper adjustment.

It should be clear to the reader that even if all the spindles were found concentric with the ring when the rail is at the bottom boss, many will not be concentric with the ring when the rail is at the top boss, and when the spindles are shimed, or packed to throw the spindle, it may disturb the position of boss, B, and for this reason, the rail should be raised and lowered many times to ascertain the proper position of the spindle when the rail is in both positions. Mill managers themselves are to blame in most cases for poor spindle setting, because if they employ spindle setters by the day, they demand that a certain number of frames must be completed. On the other hand, if they let it out as contract work, the jobber will do as many frames as possible each day, so as to get away to another job. All practical spinners will tell you that in most cases no man

CAN SET A FRAME

of spindles correctly every day.

I know that many mill men will take exceptions to the writer for such a statement, but if the reader is a mill manager, let him step into his spinning room and pick out a frame where the bobbins are nearly filled, and lower the rail and examine the position of the spindles, then raise the rail and do likewise.

If this is tried in many mills somebody will wake up to the fact that what the writer claims is true. I have myself set a frame of spindles in one day, but not often, and in some cases it has taken me two days to do one frame. No. 138.

CXXXIX. SPINDLE SETTING.

Manufacturers need not be told that good spinning is impossible unless the spindles are concentric to the ring when the rail is at the top and bottom. I have often examined a frame after the spindles were set in a hurry, and set only to the top boss, and I always found when the rail was at the bottom of its traverse that some of the bobbins almost touched the side of the ring on a frame where the bobbins were nearly filled. The best method is to employ a couple of men and set them to work, and instead of demanding that a certain number of frames be done each day, re-

quest that they be done right and to the satisfaction of the overseer in charge. It is only natural for any spindle setter to do the number of frames demanded of him, because he wants to hold his job; so he sets the spindles the best way he can in the time allowed him. How can any mill manager demand a certain number of frames to be done from any spindle setter, when no time can be fixed for doing one frame? Have it understood on hiring your spindle setters that each frame done

MUST BE EXAMINED

by the overseer in charge, and that they, themselves, are under his charge. In this way the spindles will be positioned as near right as possible, because the overseer in charge will realize that he himself will suffer the most if a hurried job is permitted. In order to have comfort afterwards and a nice running room, he will closely examine each frame of spindles after being set. There are men continually going around doing spindle setting by contract; that is, they get so many dollars for setting one frame, and the pass word is, while the job is being done, rush.

Most manufacturers have got wise to this fact, and they generally have one or two of their own men do the work, but there are still many mills that have this work done by contract, simply because the boss spindle setter has won the overseer's friendship or the overseer is not a practical man. Here is where it pays to hire men with

PRACTICAL EXPERIENCE.

All mill men know that the overseer who has had no practical experience seems out of place at all times. His method of handling the machinery and material is faulty. The writer wishes it to be understood here that he is not against textile or any correspondence school. He is a graduate of the latter himself. Both are very beneficial to any mill worker, but one must have the practical part to go hand in hand with the theory. The above is given as only one case where the work is affected, and money wasted by placing a graduate of a textile or correspondence school in charge of a room without making sure that he has also had practical experience. It has been the writer's object from the beginning of these articles to let the truth survive, and having had both theory and practice, he is in a position to judge the value of such a training. The writer is willing to admit that the practical part without theory is of much more value to a plant than the man with no practice and theory.

THE DRAFT CALCULATIONS

are of importance in connection with ring spinning frames. The draft, together with the hank of the roving, governs the size of the yarn produced. There is much arguing among spinners as to the superiority of the so-called double end, and single end gearing. Some spinners claim that the double end gearing is best, because the fast running front roll drives the back roll at the head end, and the same fast running front roll drives the middle roll at the foot end. Again, they point out that with such an arrangement, a small fast running gear drives a large, slower runing crown gear, and a small change gear drives a large, slower running back gear, There is much truth in the above claims, because the amount of strain on the gears being divided makes a perfectly smooth and even action on all of the drawing rolls. However, it must be said that the advantage over the single end gearing is slight and is important only when running the most perfect work. On the other hand, fewer gears and less labor are required to make changes with the single end gearing.

ANOTHER POINT

against the double gearing is the cost of the replacement of this extra train of gears when broken or worn. Single end gearing spinning frames are used mostly. They are easy to handle, and it must be admitted that the

best of yarns have been spun on single end gearing ring spinning frames.

Although the art of drafting is very important in connection with ring spinning frames, it receives as a rule very little consideration, and is the most abused operation about a ring spinning frame. Perfect drafting means to provide throughout the whole length of a cotton strand fibres so arranged as to be present in equal numbers at every point acted upon by the front rolls. This duty of course falls on the carder. In order to obtain such drafting the roving fed must be perfect. The writer will admit that a perfect strand of cotton cannot be produced in our present carding system. Textile schools and text-books tell us that every alternate fibre should overlap its predecessor and successor to the same extent. Again, they tell us that the drafting operation is like the overlapping found in the operation of the comber. Continuing, they say, that when a strand so formed is compressed and twisted, the chance of any rupture of the yarn is largely avoided. Every practical spinner will agree with the writer that it is impossible to attain such drafting, and that the above is all theory and worth nothing in practice. It has always been my practice to write only possibilities, and not demand that a certain thing should be done in a certain way, knowing at the same time that it cannot be done. Such work has caused much trouble for many overseers. No. 139.

CXL. EXAMINING DRAFT.

The best method to find what really takes place between the drafting rolls is to procure a good magnifying glass and examine the strand as it is acted upon by the rolls, and it will be admitted that all kinds of overlapping takes place. The frame must, of course, be run as slow as possible, in order to observe the movements of the fibres between the rolls. When a powerful magnifying glass is used to watch the drawing operation between the rolls, the variation in the fibres can be detected. You will see a certain uumber of fibres offer much resistance to the action of the front roll, while others are drawn into it in bunches.

Every mill man who will examine the action of the fibres between the rolls as they are being acted upon by the drawing rolls, will give the draft more consideration, and he will see that the rolls are kept in good condition.

The chief aim in drafting should be to have the rolls properly spaced, and in such condition that the surface of each roll will be as even as possible. As we have said, do not try to do impossibilities, but instead study always to have the necessary space between the rolls at all times, and in as perfect a condition as possible, so that the fibres will be under their influence at all times. Let us picture in our mind a speeder delivery with the second roll grooved, and the front rolls continually pulling the stock from the second rolls.

It can be seen that instead of creating a gradual drawing action, as the case would be if the second roll was in good condition, the fibres are drawn only in periods, thus not being under the influence of the rolls at all times, and only partially subjected to the draft. When the fibres are not equally drawn, weak places develop in the yarn with all the ill effects. It should be clearly seen that an excessive draft will increase the irregularity, and that anything approaching an even draft will help out such conditions. When the statement is made that the method in laying the fibres is the same as that by combing, it is very erroneous, because

IN COMBING

the fibres are returned and pieced together all at one time, at each intermittent action, and each portion follows one another. We find a different action between the rolls, each fibre here being acted upon separately; that is, the long fibres come under the influence of the front roll first, and if of considerable length, will leave the influence of the second roll last. To

make the above more clear, let us assume that the longest staple is 1¼ inch, and the space between the first and second rolls is 1 5-16 inch, it can be seen that there is only a field of one-sixteenth of an inch allowed the staple to free itself from the second roll until gripped by the front rolls. Again, let us assume that other fibres are laid side by side and passing through the drawing rolls spaced as above, the longest staple being 1¼ inches. It can be seen here that the effective drawing all depends on the position of the short fibres; that is, if the short fibres are even with the long fibres to come under the influence of the front rolls at the same time, the chances are that the short fibre will be drawn ahead of the long fibres, owing to the longer fibre remaining under the influence of the second rolls for a longer period, which retards it. If the longer fibre is presented to the influence of the front rolls one-sixteenth of an inch ahead of the shorter fibres, it can be seen that the short fibres are carried from the second to the front rolls by the longer fibres, and the short fibres leave the second rolls and enter the front rolls, while the longer fibre is under the influence of the rolls. Thus it can be seen that the short fibres are not drawn from one another, and a hand, if the longer fibres are, say, one-quarter of an inch ahead of the short fibres, the long fibre will pull away from the short fibres owing to coming under the influence of the front rolls first, and aided by the draft.

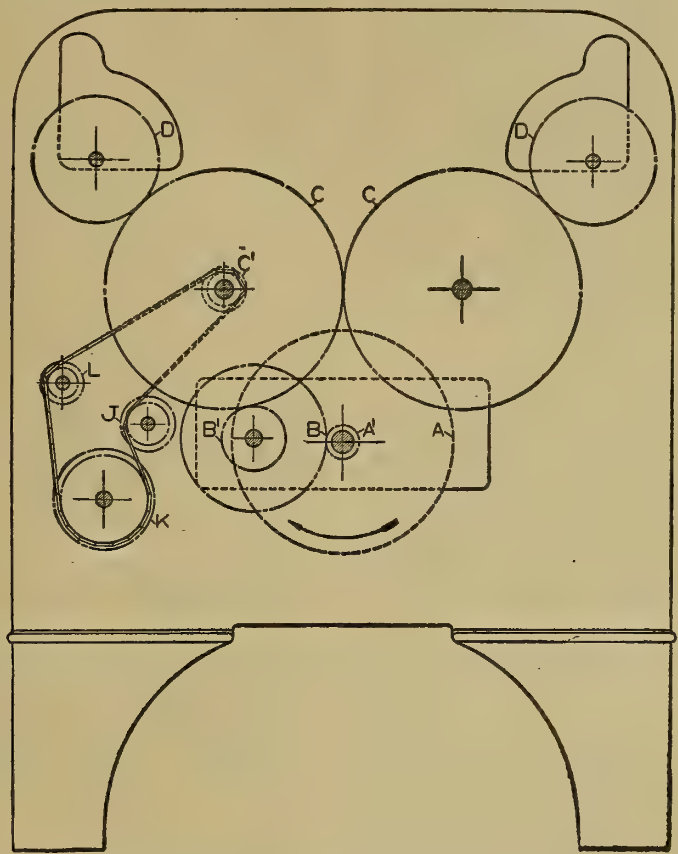


Fig. 48. Spinning Frame Twist Gearing.

The above is given simply to show that it is wrong to run irregular sta-

ple cotton, to have rolls running with uneven surfaces, and to have an excessive draft on the frame. Few mill men even consider the above fact, but nevertheless, it is this very point that throws your section beams 20 to 30 pounds on the heavy or light side. It has been explained elsewhere that a strong cotton or a long cotton will offer more resistance to the front rolls pulling the fibres apart, and from the second rolls, which retards the front top leather roll. The strand produced is somewhat heavier than it would be otherwise if the necessary space was allowed between the rolls. From the above, it can be seen that, in order to have the actual figured draft, the rolls must be given proper care and attention.

Some ring spinners will

OPEN THEIR ROLLS

only when the staple is long. They never notice wiry cotton. However, this is better than some spinners I know that never open or close their rolls, no matter what kind of stock is used. I have stated many times that any overseer who can judge when to spread his rolls or when to insert or take out a tooth of twist, when conditions demand it, is worth a great deal to any plant, and it is with regret that I must say such men are very rare.

The art of drafting is, as we have said, one of the most abused functions in most cotton mills. You will find that the majority of spinners will tell you that you should not have a draft on single roving fed to exceed 6.5. Still, these very men will change a frame on double roving and have a draft of 14 on the frame. No. 140.

CXLI. DOUBLE ROVING.

As a rule, in most cotton mills you will find four-hank roving in the spinning creel to make 28s warp single roving, which calls for a draft of about seven on the ring frame.

Now let us suppose that we change over to double roving and make the roving 4.60, which is the hank roving most commonly used to make 28s warp yarn when using double roving. The hank roving fed would then be 4.60 divided by 2 equals 2.30 hank roving. Now let us double the draft and we have 2.3 times 14 equals 32.20 yarn. The above proves this, that the amount of overlap

MUST BE GAUGED

by the number of fibres in the cross-section of the strand.

What we mean is that in order to prove that double roving is better than single, the conditions under which they are run should be as near alike as possible. From the above example, it can be seen that doubling the draft would make a very light yarn, and that, instead of doubling the draft, the draft should be shortened to the same proportion as to the reduction of the fibres in the cross-section of one of the double ends is to the draft on the frame when running single roving. The writer has seen and knows of mills to-day that have a draft of 16 on their filling frames, and 14 of a draft on the warp frames. These are in charge of men that are crying, down with double roving.

When everything we have said about the rolls being perfect and properly spaced is considered, it is a wonder how ring frames run at all under such conditions. However, conditions are found very bad where excessive drafts are used, and you will hear the weavers continually complaining. Another mistake that is made by most mill men, especially superintendents, is that they will tell the treasurer that a little longer draft in the spinning room makes very little difference in the running of the work, and that a great deal is saved in the carding room by turning off a much

LARGER PRODUCTION.

My advice to all mill managers is to have double roving. It is the only way to make a strong and even thread, besides, as stated, the face of the cloth is made much smoother. From what has been said, it can be seen that in order to have a good running spinning room, there are a number of considerations of value which are necessary to remember. Let us assume that everything is perfect; that is, that the

rolls are in good order and properly spaced with an even draft. It should be remembered that these can be disturbed by a different kind of stock. So the spinner must continually watch his work, inquire from the weaver if any cockle filling is found, and if so, open the rolls. Another excuse for not opening rolls is that if the rolls are opened to accommodate the long staple, the work will be weaker and the spinners will not be able to run as many sides. There is no doubt that spreading the rolls does affect the work in the above manner, but this is no reason why hundreds of pounds of yarn must be sent to the rope works, in addition to spoiling many rolls. Spread your rolls a little and

INSERT THE TWIST

and prevent cockle yarn. Yards of cloth may thus be saved that would otherwise find their way to seconds.

What we need to-day in our textile schools and mills is to give the young man good, practical, skilful knowledge. I like to see the overseer or superintendent who will at every opportunity take a young man and teach him all he can. You will find where such a spirit exists that every young man in such a managed plant is trying for the goal which he knows he will get if he justly earns it. There are perhaps many young men who will read the above who are today spoiling their chances.

No. 141.

CXLII. DRAFTS.

Every young man should learn how to draft all machines in a mill; he should also learn how to figure out the twist per inch and other calculations. It is all easy, and a little effort may make much difference in his life, and also in his pay envelope. Every young man should fix firmly in his mind what he would like to be, and then without violence of direction, he should aim for that goal. We have in the largest cotton manufacturing cities textile schools which can be attended free of charge.

For calculating the draft of a spinning frame, the rule is the same as for other machines. Rule: Consider the back roll the driver; multiply the diameter of the front roll and all the driving gears together for a dividend; then for a divisor multiply the diameter of the back roll and all the driven gears together. Example: diameter of front roll, one inch or eight-eighths; diameter of back roll, seven-eighths; crown gear, 84; front roll gear, 27, Back roll gear, 86. Draft gear, 45. 8x84x86 divided by 27x45x7 equals 6.79 draft.

To find constant, leave out draft gear, as was explained elsewhere, or multiply the draft by the draft gear: 45x6.79 equals 305.55 constant. From the above example it can be seen that it is an easy matter to find the figured draft, but to be able to judge the relative position of one pair of rolls to another, which is governed by the length of the staple and bulk of cotton being used, and the speed of the rolls which makes drafting an art is what counts in the work produced. One point that must not be forgotten when drafting a frame is that the distance between the centres of each pair of rolls must always exceed the

AVERAGE LENGTH.

of the staple of the cotton being used by at least one-sixteenth of an inch. From explanations already given it should be seen that if the space between each pair of rolls did not slightly exceed the length of the staple, the fibres would come under the action of the front pair of rolls before they were released by the preceding pair, and as the front rolls' speed is higher than that of the preceding pairs, a dual operation exists between the long staple and each pair of rolls. If the fibres are strong enough to resist the strain, the front roll will slightly lag behind, and, in most cases, the leather covering is injured. When a front roll lags behind, the twist runs up to the bite of the front rolls, and when the long staples are released, the shorter fibres are wound around the longer ones, which constitutes a hard end or cockled yarn.

The above is just what occurs when the stock comes in better and you

neglect to open out the rolls. To the writer such neglect seems as bad as stealing, because by your own neglect, you are wasting money and besides receiving money in your pay envelope that is given you to attend to such duties. Although we are sometimes told that drafting is all theory, from what we have already said it can be seen that drafting is

AN ART,

and requires experience, judgment and diligent study.

For this reason, it is impossible to lay down rules to be followed in books and textile schools. We will just cite the following case that would make the inexperienced helpless: Let us suppose that in dog days the work in the card room is running so badly that the carder must insert considerable twist in order to put through a fair production. This move on the part of the carder will, of course, make the yarn much heavier in the spinning room. Not having experience, instead of sizing and examining the roving, the spinner will increase the draft by changing the gears. Now, reader, can you imagine the amount of damage that such a move will do to the rolls. The yarn is made heavy by the slight increase in the twist per inch in the roving, and also due to the fact that it is more difficult to draw the fibres past each other when the strand fed contains an excess amount of twist. The experienced spinner, when the work changes, will examine the roving by pulling a few arm-lengths of roving from the bobbin, then let the two strands come together, and see how high up to the hand they will twist themselves. This, of course, requires judgment. Then he will size the roving, and if to his judgment the roving is made slightly heavier by an extra amount of twist, he will at once give orders to have the rolls spread to a certain amount, his experience enabling him to judge the proper distance. No. 142.

CXLIII. TWIST.

To make an absolutely accurate calculation of the necessary number of turns that should be placed in the yarn is the most difficult task in any cotton mill.

In explaining the above subject, the writer will give practical proofs and suggestions, and not take the diameters of the fibres which most writers claim affect the thickness of the yarn. We give below a little theory before giving the methods of inserting the proper amount of twist in the yarn just to show how such explanations are misleading. We are told, by men considered experts that cotton is naturally possessed of good spinning qualities, owing to the structure of the fibres having a natural twist, which induces the interwinding of the fibres with one another which, of course, helps the conditions while passing each process, because it is not necessary to have as much figured twist to the inch with such a constructed cotton fibre. Then they go farther to help discourage the student, and say that when mixing he should be very careful to notice in what direction the fibres are twisted, as this affects the twist of the yarn.

The writer is a practical man, and in his mill life has often seen young men try to put such statements in practice. They

BECAME DISCOURAGED,

because they really believed that their judgment was very poor, so this sentiment clings to them, and instead of reaching the goal they sling shuttles all their lives. All practical men will agree with the writer that in a cotton mill the natural twist in the staple is not considered. The only and best way to quickly determine the amount of twist in the staple, is to give the portion of cotton, when sampling, a quick pull, and if the staple consists of many semi-spirals the action will be heard the same as when crushing a handful of snow. It must be understood that the writer is willing to admit that these convolutions assist in the formation of a strong thread, and that the convolutions will interlock

with one another, and help to resist any tension put on the yarn. To ask a carder to determine the direction of these convolutions at mixing time is out of reason, and if the reader is a practical mill man, he will admit that such a practice is never found to exist in any cotton mill. What all practical men and textile schools should teach, is that the twist comes under local conditions, and that the necessary number of turns to the inch is a matter of judgment, experience, and study and cannot be obtained by certain constants multiplied by the square root of the yarn. To

PROVE THE ABOVE

let us assume that all the mills in the United States are using one-inch American cotton, and that they are all running 28s warp yarn, thus the twist per inch would be the same in the North as in the South. The reader, if a practical mill man, must admit that the above does prove that the twist comes under local conditions.

The twist that may suit a mill near the water in New Bedford, will never do for a mill in the centre of Fall River. The above is simply given to prove that the tables are only handy to get an approximate idea. Another point in finding the twist per inch to be inserted in the yarn is that the conditions under which the frame is run, must also be considered. A frame running single roving requires more twist per inch than a frame running double roving.

This is one of the reasons why double roving is much preferred. The cloth has a much smoother face, besides a greater production of a better quality is produced. One point about twist that should be remembered is if too much twist is put into the yarn made up of fair cotton, the yarn will not be strengthened, but weakened. However,

WITH SHORT COTTON,

the greater the amount of twist inserted into the yarn the stronger the yarn. Many elaborate tests are often made in the different textile schools and they, too, agree with the writer on this point, but they do not give the reason why an extra amount of twist will weaken the good and fair staple, and help the short staple in all cases. The following reason is given which the reader may accept as one man's opinion.

For the convenience of illustration, let us assume that we braid long and short hair. The reader should quickly see that the harder the hair is braided or twisted, the more difficult it is to extract one of the hairs from the strand.

The reason for this is that the hairs are so compact that each offers a certain amount of resistance to the other, and as each end offers a certain amount of pull, the long hair is consequently parted in its central part. From the above, it should be seen that the longer the hairs the more resistance is offered to the hairs slipping by one another, owing to the long hairs having a larger bearing surface. Now let us picture short cotton being twisted into a strand, and at the same time holding the above explanation in mind, it should be clear to the reader that, owing to the ends being so near together, very

LITTLE RESISTANCE

is offered to either end following the body of the fibre, and the staple is not injured. The above is the very reason why we must have less turns to the inch in the finished roving, otherwise the long fibres would be strained or broken. If the above is considered, it shows that it does require judgment, experience, and study. As we have stated elsewhere, many inexperienced overseers run their room according to tables and text books, which is the cause in most cases for deplorable conditions found in a cotton mill. We have already given an example pertaining to the loss of twist from the beginning to the ending of the bobbin, proving that instead of a loss of 7.7, as given in Nasmith's "Students' Cotton Spinning", the loss was found to be less than a quarter turn. No. 143.

CXLIV. TWIST CALCULATIONS.

For calculating twist consider the whirl a driver. Multiply the diameter of the whirl by all the driving gears, and the circumference of the front roll, and divide the product into the diameter of the cylinder, multiplied by all the driven gears.

Continuing, if the whirl is three-quarters of an inch, consider it 3, and also put the diameter of the cylinder in fourths. If it is seven inches put it 28. If the whirl is seven-eighths of an inch, use seven in

THE CALCULATION

and 56 for the cylinder. Example: Cylinder seven inches, whirl three-quarters of an inch, cylinder gear 25 teeth, crown gear 100 teeth, twist gear 56 teeth, front roll gear 112 teeth. What is the twist, with 10 per cent allowance? 28x100x112 divided by 3x25x56x3.14 equals 23.77 less 10 per cent, equals 21.40. Now let us examine the above, and we find that no allowance is made for the diameter of the band, which is usually one-eighth of an inch thick.

Now a great many spinners refuse to accept such calculations, claiming that the difference is so small that it should not be considered. We must admit that the thickness of a belt will affect the speed, so why not a band? Again, it is only fair to assume that there is only half of the band acting on the whirl of the spindle, so we should allow one-sixteenth of an inch for the band. Using the above figures and allowing one-sixteenth for the band we have: 113x 100x112 divided by 13x25x56x3.14 equals 22.15 twist to the inch, not counting the number of revolutions made by the bobbin in excess of those made by the traveler. 23.77 minus 22.-15 equals 1.62 turns. 22.15 less 10 per cent equals 19.93.

Assuming in the above example that the diameter of the bobbin is seven-eighths of an inch, and one inch of strand delivered, we have 1 divided by 3.1416x⅞ equals .36 turn. 1.63 plus .36 equals 1.99, or nearly two turns. So we find

THE ACTUAL TWIST

per inch in the above method to be 19.57 and not 21.40 as given. Some say that, as in other calculations, the twist multiplied by the twist gear equals the twist constant. Such a statement is misleading, because it depends upon whether the constant is a dividend or a factor. Of course, the writer is willing to admit that it is very seldom that a spinning frame is so hung as to make the constant a factor. However, all makes of machines, such as speeders, spinning frames and looms, that are run to-day, can be, and are in some cases, hung so as to make the constant a factor. Again, some say that the best way to ascertain the twist is to mark a bobbin and count the number of turns it makes while the front roll revolves a certain time. Divide the number by 3.1416, and the quotient is the actual twist per inch. Now from what we have already calculated, it can be seen that such a statement is very erroneous, and misleading, and it is for such a reason that the writer deems to explain it here.

Not having the

NECESSARY TURNS

to the inch in the yarn is the chief trouble in our cotton mills to-day, because, in most cases, the wrong method is employed to find the figured twist, and besides, the spinner in charge is unable to judge by examining the yarn produced whether the yarn has enough or too much twist to the inch.

The writer gives below the proper method of finding the actual twist per inch. However, there are such variations in the staple and so many different local conditions to consider, even when employing this method, the right number of turns will not be inserted at all times. Still, it must be admitted that you are always on the safe side with the following method, and everything considered, it is the only practi-

cal rule for spinners who are poor judges of cotton. First find the speed of the spindle with the device shown in Figure 40 (see our issue of March 2). Next find the number of revolutons per minute of the bobbin necessary to take up the amount of yarn delivered per minute by the front roll. Next subtract the number of revolutions per minute of the bobbin from the revolutions per minute of the spindle. Let us now assume that the spindle is making 9,000 revolutions per minute and the front roll delivers 360 inches per minute, what would be the speed of the traveler when the bobbin is one inch in diameter? 360 divided by 1x3.1416 equals 114.59 revolutions per minute of the bobbin necessary to take up the amount delivered by the front roll. 9,000 minus 114.59 equals 8885.41 revolutions per minute of the traveler. To find the actual turns per inch multiply the revolution of the front roll by its circumference and divide this into the speed of the traveler.

From the above example, it can be seen from the diameter of the bobbin, that a one-inch front roll must make 114.59 revolutions in order to deliver 360 inches of roving. So using the above rule, we have 3.1416x 114.59 equals 360. 8885.41 divided by 360 equals 24.68 actual turns per inch. Mill men should clearly realize the benefit in using the above rule, and if put into practice, it will be found that the yarn produced will give very little trouble. No. 144.

CXLV. TENSILE STRENGTH.

I have in mind a large plant in Fall River which will never allow the speed matter what kind of cotton is used, or what the atmospheric changes might be, and all hands must struggle along and accept conditions as they are. We find in the last new mill built by this plant, that the conditions in every department of the mill are deplorable.

The reason is that the yarn lacks the necessary amount of twist, and when it reaches the spooler, the least friction when passing the guide will snap the yarn. The overseer in charge said he could put his knife blade in the spooler guides, but that we must have them opened or lose our help. He said that besides the yarn having too little twist it was very lumpy, but if the necessary amount of twist was inserted the guides could be set closer, but not as close as in other mills. At the warper, the overseer had to continually take a certain number of bobbins out, because the warper tender was unable to start it up. On the slasher, one or two ends would snap and entangle the others and bring them down also. This, combined with the poor work already made on the warper, making it impossible to produce

GOOD WARPS

for the weavers.

When such conditions exist, you will find a large amount of good cotton finding its way to the waste house, and the cloth produced piled into seconds, unless the company has a printing plant to cover up mistakes. The above conditions exist in this new mill at this writing, and also in a few other mills. You will never find such conditions existing in a ring-spinning room with a practical man in charge, unless, as in the mill quoted above, the overseers are not allowed to change their twist gears. Another point that should be considered is the strength of the cloth, as well as the yarn. When a mill owns its own printing plant, the cloth is handled with care, and no one suffers from this weak yarn and cloth but the consumer. But with other mills which must send their cloth to bleacheries and print works, the strength of the cloth is an important consideration, and many mill men know that many yards of cloth are often returned, owing to it not having the

NECESSARY STRENGTH,

both traverse and lengthwise. Cloth is subjected to a certain amount of stretching in all bleacheries and print works, and the yarn must have the necessary amount of turns to the

inch, otherwise there is trouble. The writer has recently had the pleasure of meeting a gentleman who studied the conditions abroad.

This man, I class as a mechanical genius. He said that the yarn in England was superior to the American yarn, simply because more attention was given to its construction. The speeds are changed to accommodate the stock run, and no matter how slow the front rolls must be run, the necessary number of turns to the inch are always inserted. Then when the yarn reaches the loom, it can be driven at a much higher speed.

To the writer, it seems as if it would pay the American manufacturer to install more machinery and run the stock through a little slower with the proper attention, then speed up the looms. This certainly would reduce the cost somewhat, besides the cloth would be of a better quality. All practical mill men know that the weaving cost is much higher than the cost of other departments, and by increasing the quality and quantity of the weaving, the total cost would be largely reduced. No. 145.

CXLVI. BANDING.

If the reader will refer to Figure 49, the manner in which the band fits the V-shaped groove or whirl, can be plainly seen; that is, it is obvious, that the greatest influence of the band on the whirl is where there is the greatest pressure. For this reason, it should be seen that in taking only the diameter of the cylinder and whirl, granting that no slipping takes place, the actual figured speed can never be obtained. Reader examine Figure 49, and picture in your mind what happens in a ring spinning room when very little attention is paid to the band, spindle and bobbin. Granted that the traveller is of suitable weight for the yarn run, it can be seen that the twist can be affected by not having the proper tension on the band, the spindle not properly set, or the bobbin not fitting the spindle properly.

If the yarn is even and the average band pull is nearly two pounds, and the bobbin and spindle in proper order, it will be found by using the device shown in Figure 40 (in our issue of March 2) that the loss in slippage is about 4½ per cent. If the

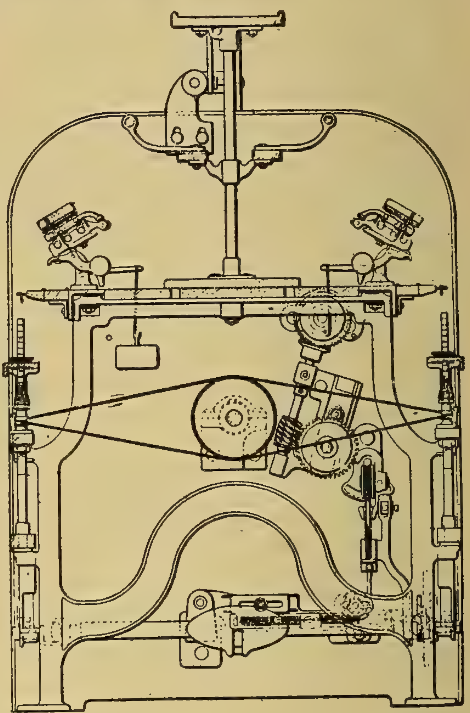


Fig. 49. Section Through Spinning Frame.

spindle speed is obtained here and there about the room, it will be found that the loss will vary from 4½ per cent to 15 per cent, and in some cases more.

Assuming that the figured spindle speed is 9,000, we have in the first case .955x9,000 equals 8,595 spindle speed, and in the second case .85x9,000 equals 7,650 spindle speed. Assuming that 360 inches are delivered by the front roll, we have in the first case, ignoring the drag of the traveller, 8,595 divided by 360 equals 23.87 turns per inch, and in the second case we have 7,650 divided by 360 equals 21.25 turns per inch, a difference of 2.62

turns. That such conditions do exist in our ring spinning rooms no one can deny, and there are some machine builders who advocate allowing 13 per cent in order to be on the safe side. Although to some this may seem to be too much, still, for a

NEGLECTED ROOM,

the above would help the struggle. The above is given so that if the reader is a spinner he may consider it and help out the spooling, warping, slashing and weaving.

Examine the bands yourself, take so many frames each week and feel of the bands while doffing or cleaning is going on, and in all cases, you will find that many bands are too slack. They should be cut off when found. Of course, many spinners will tell you that they have already too much to do, and have no time to go around feeling of bands.

There is no doubt that in the majority of spinning rooms the spinner has more than he can swing to, but who is to blame? The work in any cotton mill runs bad because the strand is not constructed properly. If the spinner gives the bands, spindles and bobbins proper attention, he is repaid two-fold in the running of his room, for instead of helping different spinners about the room, be can then be observant, and not feel that every day is his last, but enjoy conditions and feel proud of them, because there will be very little fault found in after processes.

Another good practice is to have the scrubber, or any other hand who can spare a little time, go about the room looking for any bobbin that is vibrating or raised on the spindle. They should pull off such a bobbin at once. After all the spindles have been examined throughout the room, the defective bobbins should be run on one spooler and when empty they should be fitted on one standard spindle. Ill-fitting ones should be reamed, and those that fit the top of the spindle blade too loosely should be taken to the fire room and burned. The same method can be employed to find whether all the spindles are resting on the step or not. This can be easily done when the rail is not at the bottom of the traverse, by glancing from one end of the frame to the other. All the

HIGH WHIRLS

can be detected and they should be marked, the spindle should be removed, and the bolster lowered so that the spindle will rest on the step instead of on the bolster.

A good many spinners will not even consider the above, and as stated elsewhere, there are many spinners who conceive the idea that the step raises the spindle when adjusted. The writer has continually pointed out defects, and has asked the readers to make different tests for the simple reason that the writer himself has made them, and found that such dedefects do alter greatly the construction of the yarn. You will find cotton mills where the numbers vary from one and one-half to two, while in other mills you will find a difference of eight numbers.

You will also find some mills where the yarn is fairly even, but the breaking strength of the yarn varies from 44 to 61 pounds. It should be obvious that if the yarn is even and the breaking strength varies so, the trouble is in the speed and not in the number of fibres in the cross section of the strand. These men will size and break the yarn every day, and when such a variation is noticed, instead of sizing the roving from which the yarn sized was obtained, or examining the bands, spindles, and bobbins, they quicky come to the conclusion that the trouble is in the stock. This is an impossibility, because it must be admitted that in most cotton mills there are at least 28,000 doublings of lap in the yarn produced. It can be seen that it is impossible for all the poor stock or all the good stock to follow one sliver. Be honest with yourself, and if the yarn is even and the breaking strength uneven the trouble is in the speed of the spindle or bobbin. No. 146.

CXLVII. CHANGING TWIST.

When the yarn is sized and found even and the breaking strength uneven, it is not much trouble to go and examine the spindle on which the yarn sized was constructed. The defects found on these spindles should be a basis for the spinner to clearly realize the conditions under which he is running his room. The AMERICAN WOOL AND COTTON REPORTER has often pointed out that one weak end will stop a warper many times while running out a set of spools. If the reader is a practical spinner, he will admit that, when sizing the yarn, the difference in the breaking strength quoted above is often found. The thread breaking at 44 pounds will be a constant source of annoyance to the warper tender and to the spoolers, and after processes as well. This is the chief reason why the spooler guides are opened more than they should be, which allows large nebs and bunches to follow the thread.

Another point that should be considered when the number of turns to the inch in the yarn is changed is the contraction of twist. When the twist is inserted, the strand fed should be made slightly lighter, or if the twist is taken out, the strand fed should be made slightly heavier. Not doing this is the reason why the beams in some of our cotton mills jump so. The writer has seen beams jump from 388 to 430 pounds, while in some mills 10 to 20 pounds variance is common. Such conditions are found where the twist is changed and the strand fed not taken into consideration or by the spinner being a poor judge of cotton. Such conditions make

UNEVEN CLOTH.

You will find the cloth in mills where such conditions exist to be either a quarter of a yard lighter or heavier than the standard. Few mill men consider the above, but let me ask if it is not the cause. Of course, if there are more or less fibres in the cross-section of the strand fed, the weight of the strand produced will be correspondingly affected, but what the writer wishes to convey is that when the work is even and the number of fibres in the cross-section of the strand fed remains the same, the change in the amount of twist does affect the weight of the beams.

When the cloth is lighter than the standard, the goods are often rejected, and when they are heavier than the standard, you are giving away many yards of cloth daily, which many times turn profits into losses. In order to understand how the strand produced is affected by the different number of turns inserted in the yarn, let the reader stop and consider that if the circumference of the front roll is multiplied by its revolutions per minute, it gives the distance that a point on its circumference travels in one minute. This corresponds to the length of untwisted yarn delivered from the front roll if no frictional contact takes place between the front top leather and bottom steel rolls. Now even if there is no frictional contact between the two front rolls, the strand is shortened. As the twist is inserted in the stock, it contracts slightly, and the actual length of the yarn is usually assumed to be 4 to 8 per cent less than the delivery of the front roll. This amount depends upon the number of yarn spun, and the twist per inch inserted in the yarn spun and the kind of stock used.

Another point that must be considered about the twist in the yarn is that local or temporary conditions in the humidity of the room reduce the speed of the traveller, and for this reason, as stated elsewhere, it becomes necessary to put in a little more twist to compensate for the reduced speed. When there is much humidity in a

RING SPINNING ROOM,

the path of the traveller is made harder; that is, the surface of the ring is not as smooth as when perfectly dry. It must be understood here that the speed of the traveller is reduced very little, and although the reduced speed is given as the

reason for inserting a slight extra amount of twist, the chief cause is the pull on the yarn. It should be seen that even if the speed of the traveller was not affected the yarn must be made stronger by an extra amount of twist, in order to enable it to overcome the resistance offered to the traveller. Another point to be considered about twist is the variation with a filling wind; that is, whether the weight of the traveller is gauged when the rail is at the smaller or larger end of the traverse. Although the amount of variation is slight, it should be taken into consideration, and all spinners should try and gauge the necessary traveller to suit the tension when the traverse is at its intermediate point. It should be clear to the reader that a constant multiplied by the square root of the count does not give the required turns to the inch.

Again, combed stock does not, as a rule, require the standard turns to the inch, while carded stock used in most cotton print cloth mills, requires more turns to the inch than the standard.

One point which few spinners consider is the stopping of the filling frames when the rail is at the larger end of the traverse. From what we have said elsewhere about the yarn coinciding more with the radius of the ring when the bobbin is nearly empty, and that in such a case the pull of the yarn has more tendency to draw the traveller toward the centre of the ring, the reader should clearly see that in the filling wind when the ring is at the smaller end of the traverse the pull of the yarn tends to draw the traveller toward the centre of the ring. When the ring is at the larger end of the traverse, the pull of the yarn will tend to revolve the traveller around the ring rather than pull it toward the centre of the ring. The frames on the filling-wind should be started and stopped when the rail is at the larger end of the traverse. When the frames are started and stopped when the rail is at the smaller end of the traverse, this extra pull that the smaller end of the traverse occasions, aided by the sudden start of the bobbin, causes many ends to come down. This is why the filling frames, as a rule, start up badly, especially Monday mornings, when the rings are cold. Every overseer should instruct the spinners to stop the rail always on the large end of the traverse, and the reason should be explained to them, as it is more for their benefit if they are careful not to stop the rail on the small end of the traverse. All practical spinners see that the rail is stopped at the large end of the traverse, because they understand the disadvantage of stopping it at the small end. No. 147.

CXLVIII. BELTING.

The driving of a spinning frame is accomplished through ordinary tight pulleys, the pulleys mounted on the counter shaft or main shaft being very much larger in diameter than the tight pulley mounted on the cylinder shaft. The difference in diameters is the cause for much belt slipping found in all spinning rooms.

The reason for this is that the pressure of the belt is only on about one-third of the pulley mounted on the cylinder shaft.

The amount of belt slipping in a spinning room is best determined by timing a frame that is driven from the main shaft, then by timing a frame driven from a counter shaft farthest from the main shaft, and the results are surprising. This difference in speed will make a difference in the doffing time, and the best way to even up matters is to start the doffing on the frames driven from the main shaft and then work toward the frames away from the main shaft. When the doffing is started from the counter shaft farthest from the main shaft and worked toward the same, it is often the case that the frames nearest and on the main shaft have to be stopped on account of the bobbins filling the rings. Such conditions are found existing to-day in many spinning rooms. It is costly, because it is the same as not having

the bobbins filled the full length of the traverse. It should be seen that if the doffing is started on the frames farthest from the main shaft, the bobbins on those frames are not quite full, and as in the case when the bobbins are not filled the full length of the traverse, you are weighing wood in the spooling room instead of yarn. Why not cross all the belts driving all ring frames? It should be seen with such an arrangement that the belt would occupy much more of the working surface of the pulley mounted on the cylinder shaft and the slipping would be reduced to a large extent.

ANOTHER MISTAKE

that is made by many manufacturers is in not having belt dressing for the belts.

There are many good belt preparations on the market to-day that would certainly surprise the manufacturer in the extra amount of production made possible with their use.

No mill man can deny that what is said above is true, and that there is much belt slipping in all spinning rooms where no belt dressing is used. Still, you will find many mills where the spooling, warping and weaving are waiting for yarn, and the spinner is allowed to struggle under such conditions. In some cases, the superintendent, instead of laying out a little expense in buying belt dressing, will order the frames to be speeded higher,

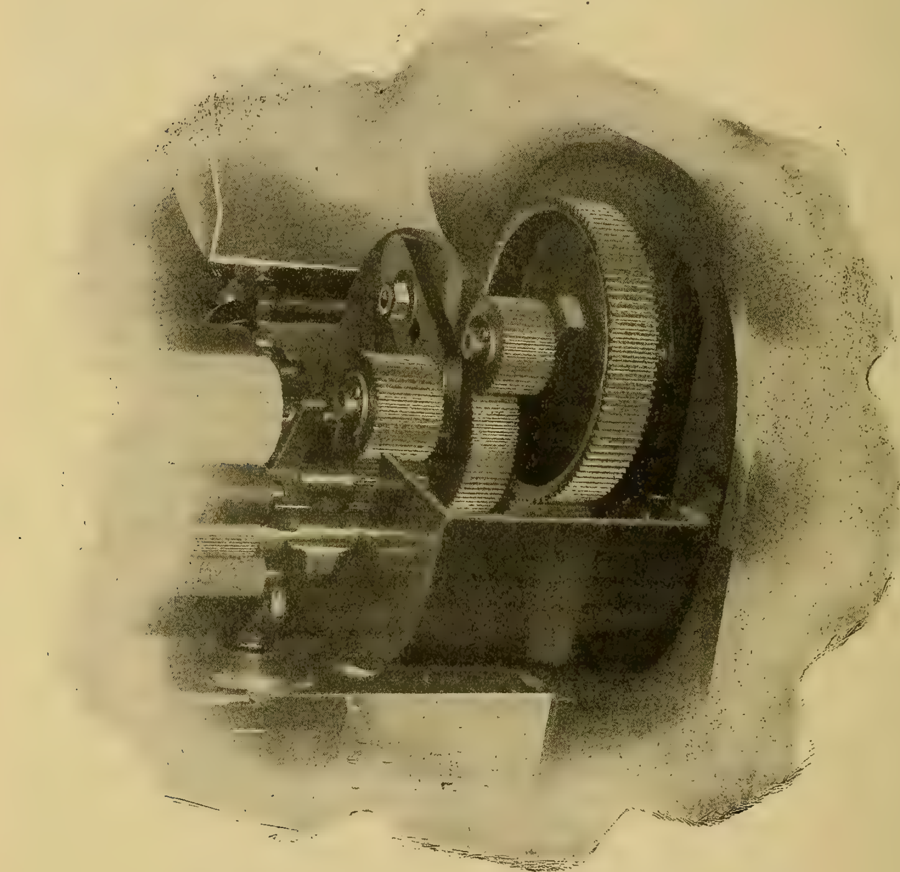


Fig. 50. Draft Gearing For Ring Spinning Frame.

causing more friction. The spinner, to save his job, will do as he is ordered, and then it is a dual between the pulleys and the machine. Fortunately, the machines gives out first The fact that the machines give out first is the only safeguard we have to check such management. Other superintendents will change the belting from single to double to run on a pulley designed to carry a single belt, with the result that the pulley is unable to stand the strain, and the end is very discouraging reading for the stockholders of the mill.

There is nothing gained by too high a speed, because it makes the work run badly, and this means a larger number of ends down at each frame. It takes very few ends down to affect the production, and for this reason, at the end of the quarter in some mills, the spinner is 5,000 pounds behind in production. When the spinner is called on to explain, in most cases he does not want to be dishonest, but does not figure on the number of dead spindles about the room, and for this reason he is as much at sea as the office. In such a managed mill, you find friction. The following rule for finding the production is given by most text books and textile schools. First, find the hanks per spindle per day. Rule:

Divide the product of the circumference of the front roll, the number of revolutions per minute of the front roll, the minutes per hour and the hours per day by the product of the number of inches in one yard, and the number of yards in one hank. Example: What would be the number of hanks per spindle, per day of 10 hours, on a frame with a one-inch front roll diameter which makes 120 revolutions per minute? Solution: 1x3.1416x 120x60x10 divided by 36x840 equals 7.48 hanks per spindle per day. Next, to find the number of pounds per spindle, divide the number of the yarn into the number of hanks turned off per spindle. Let us assume that the number of yarn in the above case is 30s; we have 7.48 divided by 30 equals .249 pounds per spindle. Then we are told that certain necessary allowances must be made, owing to the stoppages necessitated by oiling, cleaning, break downs and doffing. Then they give us a table for allowances usually made. For 5s to 10s yarn allow 12 per cent; 10s to 20s, 11 per cent; 20s to 30s, 10 per cent; 30s to 40s, 9 per cent; 40s to 60s, 8 per cent; 60s to 90s, 7 per cent; 90s to 110s, 4 per cent; 110s to 130s, 2 per cent.

All

PRACTICAL SPINNERS

know that the reason for the variations in the above allowances is owing to the coarse yarn requiring more frequent doffing than the fine yarn, for the bobbins are filled in a shorter period of time. Now let us examine the above method. In the first place, it must be said that when a large number of ends are down a large amount of waste is made if the strand fed is not broken back. In a spinning room of about twenty thousand spindles, the amount varies from two to four hundred pounds per week. The amount depends upon the number of the yarn run, also upon the conditions under which the room is run No allowance is made in the above method, and although the writer is willing to admit that it is almost an impossibility to have a certain percentage of allowances, it does prove that with the above method it is only guesswork. The above method is employed by most spinners, especially by spinners that have had no practical experience. In the second place, in most all cotton mills running a certain number of yarn, this number is reported every week, and at the same time, the numbers vary in some mills from 2 to 3 numbers, while in others, like the ill-managed mill, a variation of 4 to 8 numbers is a common occurrence. Now all practical mill men will agree with the writer on this point; namely, that when a mill is running, say, 28s warp yarn, no matter how the yarn sizes, whether it sizes 26s or 29s, 28s is reported every week in the majority of cotton mills.

Again, when the roving is sized, it is taken from a certain number of roving that was sent by the carder, which is termed as the day's sizing by all practical men. This yarn is sized and broken on the breaking machine, and the numbers of the yarn found daily are averaged up at the end of the week, and put on the weekly report as the average yarn run. Others employ another method, which, although not the proper one, gives a better estimate than the latter method. The

YARN IS SIZED

as in the first method from the roving sent by the carder, but it is only sized and broken simply to test the construction of the yarn, to see if the proper amount of twist is in the yarn for the different kind of cotton that is liable to come in at any time, and the strength necessary to turn the spools on the warper is gauged here. For the average number of the yarn a bobbin is taken from each side around the room, and the daily average size is averaged at the end of the week, and put down on the week's report as the average yarn. As stated, the above will give a fair estimate, but it does not give the actual weight of the yarn. No. 148.

CXLIX. WEIGHT OF YARN.

After the yarn is constructed at the ring frame for cloth manufacture, it must be spooled, warped and slashed. If the spooler guides in which the yarn must pass through are properly set, the yarn will lose a slight amount of weight, the action here being similar to the yarn passing under the traveller on the ring frame.

On the warper, the loss of fibres in the yarn is very little, and should never be considered, but owing to the spools being situated at so great a distance from the measuring roll, the amount of stretch is great, and to such an extent that the weight of the yarn is very much affected, especially if the yarn contains very little twist. On the slasher, the yarn is again stretched, because a certain amount of friction is added on the first few beams, and aided by the weight of the beam itself makes the strain on the yarn very great. Consequently, more stretching takes place, which again lightens the yarn. There is only one way to find the actual weight of the yarn, and that is, by dividing the weight of the beams into a certain constant. Rule to find constant for beams: Multiply the number of yards in one rap by the number of ends in the beam, and by the number of raps on the beam and divide by 840. Example: What is the number of yarn on a beam weighing 397 pounds, number of ends 390, number of raps 7, number of yards in one rap 3,000. 3,000x390x8 divided by 840 equals 11,142 constant. 11,142 divided by 397 equals 28s yarn. The weight of the beam can also be found by dividing the number of yarn into the beam. 11,142 divided by 28s equals 397 weight of beam. It can be seen that when the number of the yarn is obtained by the above method, you get the actual weight of the yarn without making any allowance, and very little figuring, as compared with methods given above. Besides, the small amount of weight of yarn that must be run on the beam at the beginning of each one, makes up for the stretching of the yarn at the warper, which helps to give the right scale to pay for the number of yarn run. At the end of each week, find

THE AVERAGE WEIGHT

of all the beams, and divide into constant. What is the average yarn on four beams weighing 397, 396, 398, 397? 397 plus 396 plus 398 plus 397 divided by four equals 397. 11,142 divided by 397 equals 28s yarn. Of course, the number of beams turned off in a mill varies from 20 to 200, the above being given simply to show how easily the actual weight of the yarn can be found. Again, with the above rule the average number of yarn can be found if the same number of ends is on every beam. Suppose you are making 36s, 50s, 70s and 80s yarn on separate beams, what is the average

number of the yarn? The weight of the beam of 36s yarn would weigh 309.5 pounds, the weight of 50s yarn 222.8 pounds, the weight of 70s yarn 159 pounds, the weight of 80s yarn 139 uounds; 309.5 plus 222.8 plus 159 divided by 139 divided by 4 equals 207.5 average weight of the beams. 11,142 divided by 207.5 equals 53.69s average yarn. In textile schools and text books, the following method is employed to find the average number of the yarn being produced. Rule: Multiply the number of pounds produced by each frame by the counts of yarn being spun. Add the results thus obtained and divide by the total number of pounds. Using the above figures we have the following:

309.5	x 36 equals	11142	
222.8	x 50 equals	11142	
159	x 70 equals	11142	
139	x 80 equals	11142	
830.3		44568	divided by 830.3 equals 53.68s average number of yarn.

It can be seen that the above method would take up much time, and the result would be the same. Even if tnere were a different

NUMBER OF ENDS

in each beam, by first finding the constant for each one the average number of yarn can be found which would be a much shorter method than the one given by textile schools and text books. Of course, the writer is willing to admit that if the constant must be found in each case the operation would be just as long, but as a rule in all cotton mills the number of ends in the beams are seldom changed, and when a table of constants for every beam is once made, it can be used to advantage at all times afterwards. Below we give such a table to show how the carder or spinner can tell by the weight of each, how much the yarn produced varies:

Number of ends.	Weight of beams.	No. yarn.	Constant.
390	397	28s	11142
367	374	28s	10485
357	364	28s	10200
344	351	28s	9828
300	306	28s	8571
371	378.5	28s	10600

Let us assume that a mill is running a certain style that calls for 367 ends in each beam, which should weigh 374 pounds. If the beams are found to weigh 390 pounds, what is the weight of the yarn on the beam?

Referring to the above table, we find the constant to be 10,485 divided by 390 equals 26.88 number of yarn on the beam. Now let us assume that the beams in the following week are weighing 370 pounds; 10,485 divided by 370 equals 28.34 minus 26.88 equals 1.46 variation. It can be seen from the above that the actual conditions can always be figured from the beams, and secured in no other way. Besides, you get

THE ACTUAL WEIGHT

of the yarn, the variation, and the actual weight of the beams from a certain number of yarn produced at the ring frame. All spinners and carders should have such a table of constants for use at the slate where the weights of the beams are reported. No mill superintendent or manager should calculate a piece of cloth from the reported sizings from the reel, because there are so many tricks to the game that the writer has found that the weight of the beams only can be depended upon, and in some cases even here, you will find the beam heads wrongly marked. No. 149.

CL. - PRODUCTION.

In some mills you will find that the overseers are familiar with the stretch of the yarn at the warper, and they give the arms of the reel one turn so as to reduce the diameter of the latter. They know full well that the reel is seldom if ever measured, and that the superintendent will accept the number of the yarn found. This enables the carder and spinner to run their work a little heavier, thus obtaining a much larger production, but of a shorter length. The construction of the reel, on which the ends are wound in coils or layers, depends upon whether it unwinds the yarn from cops or bobbins. However, the central part on which

the arms are mounted which constitutes the reel is as a rule 1½ yards or 54 inches in circumference. The writer has often

FOUND THE CIRCUMFERENCE

of the reel in many cotton mills to measure 52 inches, and in some cases 50.

The writer has in mind a mill where the diameter of the reel was slightly reduced, and even the sizeing found at the reel was changed and made still lighter before it was handed to the superintendent. The beams which should have weighed 374 pounds were found to weigh 404 pounds, but on the slate we found 374 pounds, or in other words, the slasher man deducted 30 pounds from the weight of each beam. Now in a cotton mill of about 20,000 ring spindles the warpers should turn off about 60 beams of 28s yarn. 30 pounds deducted from each beam would give 30x60 equals 1,800 pounds, or almost the weight of five beams. This overseer received beams from another mill of the same plant and he would count from 3 to 5 of these beams with the 5 obtained in the above method, and they were distributed among the warper tenders, thus increasing their pay. Such conditions existed for a long time, and the cloth was found 30 and 40 points heavier than the standard, and from what was said above, it can be seen that the difficulty was hard to locate. The superintendent was formerly a machinist, and knew very little about the operation of a cotton mill. Consequently, the mule room suffered, because the filling had to be made much lighter to bring the cloth somewhere near right. Making light filling is quite

AN EXPENSIVE ITEM,

and besides the production is greatly reduced. From the above, it can be seen that not only were these beams paid for, but they were counted in the production a second time. This same overseer has had as high as 64 sides stopped at one time, and it never was discovered by the superintendent. The above is simply given to show the mill men that if the number of beams are watched, and also the weight, it is impossible for a dishonest overseer, like the one mentioned, to lead the superintendent astray. Another costly practice found in many cotton mills is allowing a considerable length of yarn to be wound on each beam before the measuring motion is set. This not only reduces the production, but a great amount of waste is made, which is very costly at this stage of manufacture. However, this will be treated more fully later.

Many carders are obliged often to insert a little extra twist into the roving on account of a little breaking back at the ring frame, when the real trouble is in the condition of the skewers in the creel.

All practical spinners will agree that they are much neglected, and that there are very few spinning rooms to-day but that are running skewers that should be changed. Like other moving parts of a frame, the bottom of the skewer will wear out. In some cases the tenders will hammer the bottom of a skewer which causes it to offer

A SLIGHT RESISTANCE

to the unwinding of the roving. It is often found in the spinning creel that the vibration will unwind the roving faster than it is taken up by the drawing, and a certain amount accumulates, and a number of coils are drawn into the drawing rolls which cause the end to come down.

For this reason, the skewer should be hammered slightly, but the best of judgment should be used. Help should not be allowed to hammer them to such an extent as to offer any resistance to the strand unwinding the roving from the bobbin.

It must be said that in most spinning rooms very little is lost, both in twist and production, from the above practice. However, as stated, there are many spinning rooms where much cockle yarn is found, and many rolls grooved and cut, the cause of which can be laid to the above prac-

tice. Many spinners, while walking through each alley on noticing the roving broken back here and there, run to the carder for more twist instead of examining the skewer. In some cases, the roving breaks back on account of dirty skewers, the bottom of the skewers collecting the fly when the spinners are allowed to blow off, as it is termed. Many spinners, instead of using a hand brush provided for such a purpose, will use a piece of cloth tacked on two sticks about twenty inches long, and the fly

IS BLOWN OFF

by the draft that this device creates. Blowing off should not be allowed in any room of a cotton mill, because when this method of cleaning is employed, the fly collects in bunches, which gather on the yarn and form a bad looking place.

Besides, such a practice causes a loss of production in the spinning and card room, because as was explained when twist is inserted in the roving, the front roll speed must be reduced. In the spinning, too, much twist will cause cockle yarn, besides spoiling many top rolls, and injuring the fibres. Another point that is overlooked about creels in many spinning rooms is in not having the creel boards of a proper height. Often you will find many spinners bothered taking out an empty bobbin and putting in a new one, owing to the creel board being a little too low. The creel board should be set so that the top of the skewer will be about one-eighth of an inch from the surface of the top side of the creel board, so that, besides making it more handy for the spinners to take out and put in the roving, anything that may be lagged on the creel will not come in contact with the top of the skewers. Many spinners set their creel boards so that the top of the skewer will be just even with the surface of the top side of the board, seeming to forget that at times when a large number of roving is on the creels they are lowered, and for this reason, the above allowance should be made. No. 150.

CLI. SPINNING COSTS.

From what we have said, it can be seen that it is impossible to obtain the actual production from the speed of the front roll.

Even if all the spindles were kept in operation, the actual production could not be obtained from the speed of the front roll, owing to atmospheric conditions affecting the work to such an extent, as to greatly affect the production. Again, there is a difference in speed from one line of frames to another, and sometimes the speed of the whole room varies So the only way to find the actual production is from the weight of the beams. There you get also the actual average yarn. You are then on the safe side, and you will not take off a thousand or two more pounds of yarn than the carder in roving This amount may not look very large, but when totalled up at the end of the quarter, it is in some cases a week's production, then there is trouble.

There is, of course, a certain amount of waste made between the ring frames and the warpers, but the amount is very slight in most mills, and it is much better to sacrifice this small amount and be a little under the actual production than over. There are times, of course, through breakdowns or shortage of help when the warpers may be stopped for a considerable period of time, while the frames are continually kept in operation. It then becomes impossible to obtain the actual weight from the beams.

When this happens, the best thing to do instead of finding the production by the speed of the front roll, is to average all the weekly production reports for twelve weeks back, thus giving you a more accurate report. Below are given the methods and also a report of the warp and filling department for the benefit of learners and spinners who are continually in trouble over taking off too much production.

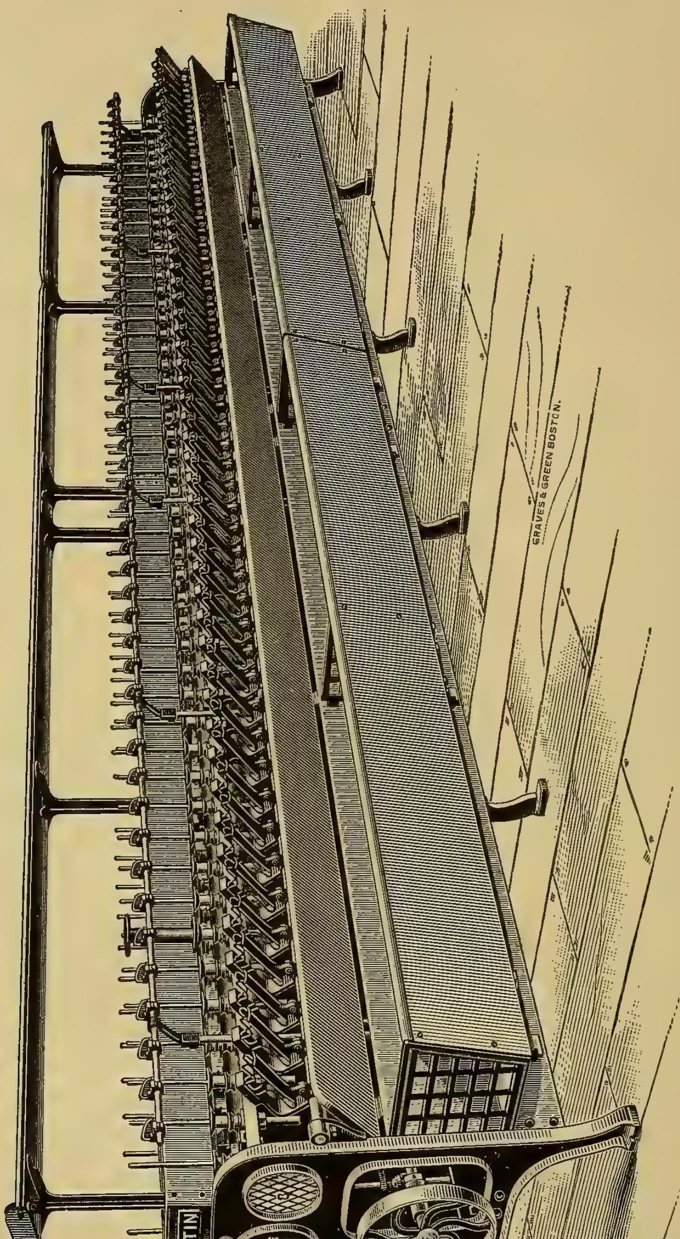


Fig. 51. The Spooler.

The first thing to do in making out your production report, is to find the number of beams taken off for the week, then total up the number of pounds. Let us assume that 68 beams total up 26,533 pounds of yarn, and the spinning room has 20,000 ring spindles. One-half the beams contain 390 ends and the other one-half 367 ends. For the convenience of calculation, let us assume that 34 beams of 390 ends weigh 13,977 pounds, and that 34 beams of 367 ends weigh 12,546. 12,546 divided by 34 equals 369 pounds on each beams; we now divide this average weight found into the constant for 367 ends and we have 10,485 divided by 367 equals 28.57s yarn. 13,977 divided by 34 equals 411 pounds on each beam. Constant for 390 ends 11,142 divided by 411 equals 27.11s yarn; 27.11 plus 28.57 equals 55.68 divided by 2 equals 27.84 average yarn. We next find the production per spindle: 26,533 divided by 20,000 equals 1.32 pounds per spindle. We then find the cost. Let us assume that there are 125 spindles to a side, and that a spinner runs ten sides for six days at .11 per side. We have 10x6 equals 60x.11 equals 6.60, which is about the average pay for a 10-side ring spinner. Some mills pay by the 100 spindles, while others pay by piece work. 20,000 divided by 250 equals 80 frames. 80x2 equals 160 sides times 6 equals 960 for the week; 960x$.11 equals $105.60 cost, or 16 spinners at $6.60x16 equals $105.60 cost. We next divide the production into the cost, to find the cost per pound for the spinning only. $105.60 divided by 26,533 equals $.0039,

COST PER POUND.

We next find the production of the filling frames. The writer employs the following method. Take one frame of the average speed, and weigh the bobbins on the first doff and the full bobbins, after doffing, and deduct the weight of the bobbins from the weight of the full bobbins, doing this every doff for a week. Let us assume that we find after weighing a filling frame of 256 spindles for a week that its production is 183 pounds of filling yarn, and the weight of the stock and clearer waste is four pounds. We have 183 divided by 256 equals .71 pounds per spindle for the week. Number of spindles 18,944x.71 equals 13,450 pounds of filling. 18,944 divided by 256 equals 74 frames. 74x4 equals 296 pounds of waste made on all frames. The only way to give an accurate report of the filling department afterwards is to weigh the waste, which is a small matter, and if less waste is made add the amount to the production. If the frames are stopped for any length of time, deduct the same per cent from the production. If the frames stopped 9 hours, 9 divided by 60 equals 16 per cent. 100 minus 16 equals .84x13,450 equals 11,298, production. There are, of course, various methods in finding the production on ring filling frames, some calculating it by the speed of the front roll, and by making a certain allowance, as on the warp. The writer has employed the first method for years and has found that it balances the production throughout the mill. We next find the cost of the filling spinning only.

THE PRICE PER SIDE

on filling is about three cents more than the warp, because a spinner is unable to run as many sides on filling; besides, as a rule, the filling is much finer than the warp, and although the front roll speed is much less, the best of help is required on the filling frames.

Assuming the price per side to be $.14 and the spinner running 8 sides, we have 8x6 equals 48x$.14 equals $6.72 or 74x2x16 equals 888x$.14 equals $124.32 cost of filling. $124.32 divided by 13,450 equals $.0092, cost per pound. We next total the cost of the warp and filling $105.60 plus $124.32 equals $229.92. We next total the production 26,533 plus 13,450 equals 39,983 pounds of total production. We then find the total cost per pound of all the yarn: $229.92 divided by 39,983 equals $.0057 cost for pounds of both yarns. The cost for

day help for the above number of spindles is generally about $183. In this case we will call the day help cost $183.79 plus $229.92 equals $413.71 total cost. $413.71 divided by 39,983 equals $.01 or practically one cent.

It will be noticed in the report that a space is left to report machinery stopped. The reason for this is that if a number of frames are stopped all week or for any length of time, the report must show a decrease in money to the amount that is required to operate them. Referring to the report, let us assume that four frames of filling are stopped all week. This would reduce the cost of filling: 2x4 equals 8x6 equals 48 sides x$.14 equals $6.72. The cost of the filling yarn would be $118.60 instead of $124.32, and the number of spindles from 18,944 to 17,920.

From the above explanations, any person should be able to make a report of the above form. Such a report is valuable to the superintendent, because like the carding report, it is not guess work, and the cost for making any style of cloth can be quickly and accurately calculated. No. 151.

CLII. DAY vs. PIECE WORK.

The following question has been put to the writer many times, which is preferable day work or piece work? The answer is that it all depends whether quality or quantity is the main object in view. There is no doubt that day work is preferable to piece work for quality, for this has been proven in the past, and the future is sure to bear witness to it. Piece work means an overstrain on the help, and they will while in such a condition allow poor work to go. Poor quality means a decreased demand, and a decreased demand results in a curtailment or reduction in wages. (See article "Ill-managed Mills" in issue of August 23, 1910.)

When the help are told that if a certain amount of production is not taken off they are going to lose their jobs, this tends to make poorer quality than before, because the help will work harder, drive their machines faster, if they can, and let more poor work go.

The demand of most manufacturers for the greatest possible production from their machines causes them, in the majority of cases, to lose sight of the fact that there is a limit to a machine's proper production, which leads to the machinery being overspeeded, sometimes to an alarming extent, as in the "ill-managed mill".

FOR FINE GOODS

and yarn, that day work system is preferrable; that is, if the manufacturers will pay as much at least, if not more, by the day as they do by the piece, or in other words, equalize it. Of course, it must be admitted, when considering production, that the speed of the front roll is the most important factor. The speed of the spindle must also be sufficiently high to give the necessary turns per inch to the yarn while the front roll is running at a fair speed, and not have it so high as to cause breakages. This is where the knowledge, judgment, and experience counts. The latter is attained by experimenting with different speeds until one is attained that will give the greatest production with the least amount of work to the spinners. This gives the spinners more time to do their oiling and cleaning. Any mill manager can increase the speed of his machines, but the question is, is it economy to do so? A large production means economy, as it reduces the total cost of a mill, and it is, therefore more economical to run all machines as high as possible, but the speed of the machine should be no higher than the the machine is designed for.

This is why the AMERICAN WOOL AND COTTON REPORTER has continually pointed out to the mill men, that it is wrong for a superintendent to give orders to speed up carding and spinning machinery, etc., without knowing the limit of a machine's

PROPER PRODUCTION.

This, as stated before, leads to the overspeeding of machines.

If the reader is a practical spinner, what would he think, if, like the writer, he should find a spinning room where the spindles are running 1,400 revolutions per minute? Such a speed is attained at this writing in one of the Fall River mills, and in order to keep the bobbins from rising on the spindles, the Fall River Bobbin and Shuttle Company make a special design bobbin for this mill. Now let us consider the mistake and unnecessary expense caused at this mill. In the first place it must be admitted that the work does not run as well with such a high speed, which means more waste. In the second place, it must be admitted that there is a greater amount of wear. In the third place it must be admitted that one of the greatest expenses in connection with ring frames is the wearing of the travellers. All practical spinners will agree with the writer that even if the spindle speed and the weight of the travellers are proportioned, that the travellers will heat by such a high speed and cause the travellers to lose their temper. When a traveller loses its temper, it quickly wears and flys off. The above is just what occurs when such a high speed is attained, and when everything is considered, it is safe to say that such methods are a loss and not a gain. One of the greatest mistakes that is made in the management of a spinning room is in the changing of the rings. Some overseers will allow the rings to be changed or turned over here and there around the room, which is one of the worst evils existing to-day in a ring spinning room, because you must have a different traveller for a new ring on account of its rough surface, and if the new rings are distributed around the room, it will be seen that it is impossible to

SELECT PROPER TRAVELLERS

to suit all rings. The only way to change rings is to order a half dozen or more frames of new rings, and put all the new rings on a certain number of frames and run a lighter traveller on these frames, then pick out all the good rings taken off where the new rings were put on, and use them about the room. In this way a standard traveller can be used for the new rings, and a standard size for the old rings. As stated, new rings require a different traveller from an old ring, but as the new rings become smooth, a heavier traveller should be used. The above is the very reason why there is a certain amount of friction between the spinner and carder in most all new mills after running a few months. The spinner blames the carder for the yarn ballooning on a dry day, claiming that the work is coming in light, when the real cause is in the new rings getting smooth after a few months running, thus requiring a heavier traveller. Another defect that can be noticed in the management of the different spinning rooms is in the

OPENING OF WINDOWS

as conditions demand.

You will see some mills open their windows on the west side and shut on the east side, or vice versa, sometimes they are opened on the north side or vice-versa, and other times they are all opened or all shut. In some mills, however, the windows are never attended to, unless by some of the help who are overcome by the conditions existing inside the room. This is an important point in managing a spinning room especially.

From what was said about the rings and travellers, it should be seen that if the weather is damp and the yarn a little heavy the windows should not be opened. The reason for this is that, owing to the yarn being a little heavy, if the windows are opened a larger amount of humidity is allowed to enter the room which is quickly absorbed by the stock, thus increasing the weight of the yarn and causing it to balloon still more, and the travellers are continually flying off. Many spinners conceive the idea that a great amount of humidity finds its way to the rings, and they point out that the rings when damp offer a certain amount of resistance to

the travellers, which they claim prevents the yarn from ballooning.

There is no doubt that there is a certain amount of moisture on all rings on a damp morning whether the windows are opened or shut, but it is obvious, too, that as soon as the frames are in operation for a short time this

MOISTURE DISAPPEARS,

and no matter how much humidity is allowed to enter the room, it is impossible for any moisture to find its way to the rings, owing to the high rotation speed of the traveller. On the other hand, if the work is light and the day damp, it can be seen from what has been said above that opening of windows will remedy conditions. When the work is light there is too much pull on the yarn, because the traveller becomes too heavy, and when the windows are opened, and a greater amount of humidity is allowed to enter the room, the stock absorbs this moisture, and the pull or the strength of the yarn is more equalized. In very dry weather, or when the work comes in very light the only remedy is either to shorten the draft on the frames, or to put on a heavier traveller. In the management of a spinning room, in order to obtain the best results, the spinner should make a careful study of the relation between the diameter of the ring and bobbin to be used for spinning different counts of yarn.

All practical spinners know that it is not practical economy to purchase new bobbins or replace all the rings in a spinning room to accommodate every change in the counts of yarn made, and for this reason, a given size of ring can be chosen when equipping a room that can be used for a range of counts with a bobbin of a given diameter, and a change in the size of the traveller to regulate the tension on the yarn is all that is required. It may be assumed that, whenever practicable, a long bobbin used with a large ring would be a great advantage by saving time in doffing in the spinning. The same is also true in filling the bobbin throughout the traverse, thus saving time and reducing the number of knots made in spooling, by running longer on the loom, as in the case of filling yarn. As was stated elsewhere, conditions outside the spinning room will put a limit upon the above by requiring the filling bobbin to accommodate the size of the shuttle, while the warp bobbin must be governed by the weight and tension that the yarn is capable of pulling when in the spooler. No. 152.

CLIII. ADJUSTMENT OF GEARS.

We have said elsewhere that at times, the deplorable conditions found in many spinning rooms can be traced to too great a difference between the diameter of the ring and the diameter of the empty bobbin, and for this reason it is difficult to regulate the size of the traveller to suit the variation of diameters and keep a proper tension at all times, resulting in bad spinning, uneven yarn, too much waste, irregularities in twist and consequently strength, all of which tend to reduce the quality and quantity of the yarn produced. The proper weight of the traveller for the yarn spun should be gauged by the pull on the yarn on the warp frames when the bobbins are one-half full, and on the filling when the rail is making its slowest traverse and when the ring is at one-half the traverse. When there is too great a difference between the diameter of the ring and the diameter of the empty bobbin on the filling frames, great care and attention should be given in stopping and starting the frames. As was stated elsewhere, this neglect is bad enough when the variations of diameters are not very great, but in such a case as referred to above the frames should be stopped and started when the ring is at the larger end of the traverse.

In a spinning room, as in other rooms, it is important that all gears be correctly set; that is, neither too deep nor too shallow, because gears that are set too deep will grind which causes friction, while if set too shallow, there is danger of the teeth

jumping one another at intervals which causes cut yarn and also much trouble in after processes. A book could be written on gears alone, about how the tooth should be made, whether round or involute. This is all right for the machinist, but it is necessary for the spinner to know how the

GEARS SHOULD BE SET.

It must be admitted that our machine builders turn out as near a perfect tooth as can be made, and there is very little chance for a spinner or carder to improve upon them, and for this reason it is better to pay attention to the setting of gears instead of their construction. The reader, perhaps like the writer, may have often entered a room and heard gears grinding here and there. It is astonishing to see how such men can be comfortable under these conditions. No honest man will allow a gear to grind in the room of which he has charge, because if he is a practical man he knows that such is a waste of money and such a neglect is just as bad as stealing. Set all gears usually about two-thirds deep although a little deeper is better, if the fixer is a person of good judgment.

Never allow your second hand or fixer in changing gears to hammer them into place, a practice that is found in almost all spinning rooms in our cotton mills. As a rule, all practical spinners have had much experience in fixing, and are capable in that line, but they seem to lack that managing ability to have their fixers so set the gear together that they will mesh freely at all times. Yarn cut from improper gearing can be detected in the cloth. The same can be said when the spinners are creeling, in allowing long ends of roving to run in with the portion pieced. Again, many ring spinners will double the end of roving in order to stiffen it so that it can be put through the hole in the guide rod to the drawing rolls more easily. Some ring spinners do not only double the end of the roving, but they also twist it very hard so that in most cases the rolls are cut or grooved. This is a practice that is found existing in almost all print cloth mill spinning rooms, and very little, if any, attention is given to it. It is only a

HABIT AND CARELESSNESS,

because in the first place the roving should not be allowed to run out, and in the second place, when the help are accustomed to it, it is just as easy to creel a roving without doubling or twisting it. The above practice is even seen in spinning rooms where double roving is found, and the only reason that can be given for this practice is that the spinners are so accustomed to doubling and twisting the roving in the mills where single roving is run, that when they are employed in a

Report of Frame Spinning Dept.

MILL NO. 1.

Week ending Jan. 28, 1911.

No. of days, 6. No. of hands, 54. Total pay roll, $413.71. Total Cost .01.

	Spindles.	Hank roving.	No. of yarn.	Production.	Per spindle.	Pay roll.	Cost per lb.
Warp	20,000	4.60	27.84s	26,533	1.32	$105.60	.0039
Filling	18,944	6.60	42s	13,450	.71	124.32	.0092
Totals	38,944			39,983		$229.92	.0057

Pay roll, day help, $183.79.

Machinery stopped............... Overseer.

spinning room running double roving they continue the habit, and are not prevented from doing so by the overseer. Almost all ordinary spinners can so construct a thread that it will weave, but the question is how will it appear in the goods after weaving, especially in shade cloth?

Another good point in the management of a spinning room is to have at least two teeth of draft between the back and middle rolls. This will greatly help the spinning, because a little extra draft at this point will help out the hard twisted places in the roving. The draft will be just as regular if the rolls are in good order, and there is a better opportunity at this point to act upon heavy or hard twisted places in the roving owing to the space between the rolls being much greater. Besides it helps out the front roll, as it is more able to extract most of the twist at this point, and the frictional contact on the front roll is not as great. In all ring spinning rooms where there are no humidifiers, the spinner should have some knowledge about

TEMPERATURE AND HUMIDITY,

but the writer has often found overseers in charge of a spinning room who never knew the difference between the two. The Draper Company has been very kind in furnishing spinners throughout the country with valuable tables, that are used by most spinners to advantage, but you will find other spinners who do not even understand them. Humidity of course, means the amount of moisture in the atmosphere, while temperature means the number of degrees of heat. From what has been said, it should be seen that the amount of moisture contained in the air of any spinning room is of importance. As a rule, it is generally found that a standard humidity of from 50 to 60 per cent of the maximum amount of moisture that the atmosphere contains gives the best results. The temperature should be between 70 to 76 degrees. Coarse yarns require a lower temperature than fine yarns. No. 153.

CLIV. BANDS.

In ring spinning the construction of bands is an important consideration. The chief point to consider is that all bands must be uniform in size even if they are not uniform in twist. Bands are customarily made on banding machines which work and stop automatically when a certain length and a certain amount has been made. They are made either from yarn or roving or of a combination of both. Bands made of roving are much more preferable than those made of yarn, because a greater number of strands are required when made of the latter, and for this reason the life of the band is greatly reduced; and, too, if the band is allowed to rub on any part connected with the spindle base, the strands quickly wear and break one by one. For the above reason, whether the bands are made of roving or yarn, the overseer should see that the position of the snout or hook on the spindle base is not such as to rub and wear the band.

Many mill managers conceive the idea that any waste material is good enough for making bands, and the fly, stripping, etc., is run through separately and the roving or yarn (usually roving) produced is used for such purposes. From what we have said, it should be seen that poor bands are far from being economical, because the main requisite of a good band is that it will not stretch, and for this reason instead of using any waste material special cotton should be bought. Every practical mill man will admit that the bands should maintain a regularity in

SIZE AND TENSION

and for this reason they should be made of good stock with a uniform staple. There are, of course, many methods of making bands, and many spinners can be found who will employ nothing but yarn to make bands, while others will use roving and yarn, and they, too, claim this method to be the best. However, the writer has employed all of the above methods and found that

bands made from all roving are best. The very best bands are made from Peruvian or Sea Island cotton, and although it may seem expensive at first, it will be found to be the most economical in the end.

What is wanted in all spinning rooms are good bands, but it must be said that very few spinning rooms use the best of bands, and, too, they are found to vary in size. If the bands are ordered from a manufacturer of banding, order them to your liking. The following is the method employed by the writer and if put into practice it will be found that the breaking strength of the yarn will be very uniform.

Use Peruvian or Sea Island cotton and make a 6.60 hank roving on your fine or jack frame, not considering the twist. Insert 7.1 turns to the inch, which will increase the weight of the hank to almost four hank roving, put up about ten roving at the banding machine at one time, and it will be found that a band will be produced that will stretch but very little and will retain its tension. The reader should easily see the mistake made by most mills by employing waste material to make banding, because if the reader is a practical mill man he knows that waste material will not make an even strand or thread, so how can an even band be made from an uneven strand. The reader should picture in his mind what would happen if a driving belt was made up of different lengths of double and single belting. It is obvious that a uniform speed could never be attained.

The same then must be said of an uneven band, and the speed of the sindle is greatly affected. Some mills use banding that is made in

ONE CONTINUOUS CORD

and supplied to the mills in the form of a large ball. Such banding should never be used, because it is almost impossible to make a good knot, and it is safe to say that the bands that are made of a length to just band one spindle with the loop on one end are much preferable, and a better knot can be formed. It is for this very reason that England is slightly behind in ring spinning, and although the reader may take exception to the above statement, it is true, nevertheless, and all expert ring spinners who have studied conditions in both countrys will tell you that it is customary in most all European mills to use bands made up in one continuous form, and that the loop band is a feature of American mills only, which enables the latter mills to spin very fine yarns on ring frames.

In managing a spinning room, the careful spinner should know the conditions required, for the yarn spun for quickness in changing the necessary relative position of the rolls, for the staple spun, also of the guide wires, rings, spindles and bands. He should keep posted about what is being done in other mills, and try and not be beaten, but be sure that the mills which are doing perhaps a great deal better than you are not using much better stock, or if they are not doing as well, be sure that the stock used is not poorer than you are using.

When a superintendent

DEMANDS MORE WORK

from a spinner, claiming that other mills are doing much beter, the first thing to do is to demand a sample of the stock used in the mills mentioned, then if the stock is found to be the same, a test should be made on a single frame only, and the speed, draft and twist on all frames should not be changed until the spinner is satisfied that the room can be run under such conditions.

Many writers claim that the mule is fast going out of fashion, and to prove the above statement they point to the equipment of modern new mills. The writer is willing to admit that with the best of combed stock filling yarn as fine as 90s, and all numbers up to 90s, have and can be spun to better advantage on the ring frames, but from 90s and above 90s the mule is much superior. When poor stock is used the mule is superior to the ring frames for spinning yarn over 50s.

Managing help in a spinning room is a very important factor in the successful operation of the room, and the spinner should, if he can, employ good, moral people who will work and do all in their power for the good of themselves and the room. But the overseer must first live up to this himself and his ability to manage help all depends on his own actions. One good point for a spinner to follow is that the busier you keep your section hands, the better condition the room will be in, and the better contented they will be. No. 154.

CLV. SPOOLING.

As is well known by all practical mill men, the spooling of yarn is a process that differs much from the preceeding processes. The object of a spooler is to assemble a great length of yarn from a number of small bobbins onto a much larger spool. In most cases, the yarn comes from the ring frames to the spooler, although much yarn is also spooled from the mule. The latter is found to exist to a greater extent in England than in America. The spooler does not affect the construction of the yarn, but it will clean the yarn if the spooler guides are properly set. The spooling of yarn is a process that involves a high percentage of labor cost if not properly managed, owing to the labor being paid at a certain rate per product, and for this reason the chief aim in the spooling room should be to lessen the element of attendance as much as possible. The bobbins received from the ring frames should be often examined to see if they are properly filled, because if this is not done, the comparatively short length of yarn on the bobbins will necessitate constant piecing, which not only reduces the production, but increases the cost in some cases to an alarming extent. Textile schools and text books give us the following method for

FINDING THE PRODUCTION

of a spooler. Take 750 revolutions per minute for the standard spindle speed, which has been found from actual practice to be 90 hanks per spindle in ten hours. The number of yarn is then divided into the number of hanks. When the speed differs from that given above, the production is then figured by proportion. For example, if the above speed was changed to 850, the pounds per spindle would be found by the following solution: 750:850 equals 90: X or 90x850 divided by 750 equals 102 hanks. Assuming the number of yarn in this case to be 30s, we have 102 divided by 30 equals 3.4 pounds per spindle. Then the number of spindles on all spoolers in operation are multiplied by the pounds found on one spindle, and the total production per day or week is obtained in this way.

Again, in quoting the above method of finding the production of the spoolers, it must be understood that it is not the writer's intenion to depreciate the value of the textile schools or text books, but to discuss the advantages of every-day practical methods employed in most mills, and at the same time, prove to the reader that most all theoretical calculations in a cotton mill are in most cases incorrect and misleading. Without a doubt the textile schools are a splendid association to the practical men without theory, and the writer is willing to admit that by them our cotton mills have been greatly benefited. But for one who is making preparations for the actual manufacture of cotton yarn or cloth, the best schooling is the mill, although the two combined are better still, for when a man receives a textile school training only, and falls into a good position through the influence of relations, he is a great

EXPENSE TO THE COMPANY

at all times, and he himself is always standing on dangerous ground.

The production of a spooler is affected by the size of the ring and also by the size and construction of the bobbin on the ring frame, whether the yarn is tied by hand or by a knot tier. It is claimed that by the use of a knot tier the production is not only increased, but the quality of the yarn produced at

the spooler is improved, due to the knots being tight and having the ends short and perfectly trimmed, which also aids in increasing the capacity of the weave room. Suppose that the following question was put to a graduate of a correspondence or textile school who employs the above method in finding the production of a spooler. Could the reader form an opinion as to what would be the answer? If two mills having the same number of ring and spooler spindles, all other conditions being the same, produce a difference of 3,000 pounds of yarn in a week, what is the reason? To the practical man this is easy, because such points are continually coming up in mill life, but to the man who has only the theory and no practice the above question would be to him one of perplexity. Again, let us ask a graduate of a correspondence or textile school why it is that the cost per pound is highest where the least production is obtained? We will answer a few defects that will affect the cost and production of a spooler that can be answered only by men who have had

A PRACTICAL EXPERIENCE,

because there are so many reasons for the above that in some cases the proper one is difficult to locate, and cannot be found simply by mathematical calculations. Running a traveller that is too light for the number of yarn spun will increase the spooling cost, because a light traveller will not lay the coils as close as the weight of the traveller most suitable for the yarn spun; consequently, each coil of yarn takes up more space and the bobbins produced are soft with uneven surfaces, and besides the length of yarn possible to be wound on the bobbin is much less. Again, yarn produced from a light traveller is much weaker than from one to suit the yarn, because the pull of a proper weighted traveller will break the yarn at the ring frame, while a traveller that is too light will allow the weak places in the yarn to pass, which results in a larger amount of ends breaking on the spoolers. This is the reason why many spinners will run a much lighter traveller when the superintendent orders the twist to be taken out in order to save himself.

A soft bobbin, as a rule, spools badly for two reasons: (1) because the bobbin is not as perfect cylindrically as one more compact; (2) the pull on the yarn necessary to unwind the coils or turn the bobbin in the bobbin holder causes the yarn to sink in the surface of the bobbin, which breaks the end down. As soon as the spooler tender finds such a bobbin, she can tell at a glance from experience that the end is hard to locate, so the bobbin is pulled off and laid on the creel as bad yarn, and besides, in losing production, you are losing good yarn.

No. 155.

CLVI. AVOIDING WASTE.

All bad yarn resulting from lax methods in the spinning is, as a rule, sold to the rope works at a very low cost, and this bad yarn is made up afterwards in banding, rope, etc. Of course, there is much bad yarn made in a spinning room that is inevitable, caused by the lifting rods sticking, or the builder getting out of order, etc., but in most spinning rooms or spool rooms you can trace the cause of most bad yarn to lax methods in the management of the spinning room. It can be seen from the above that a light traveller does affect the cost and production of the spool room, but not as much as a large diameter bobbin and a small ring, or a bobbin not filled throughout the length of the traverse. The above will show, when explained, that a great mistake is made when the diameter of the empty bobbin is increased to lessen the pull on the yarn at the ring frame, and many superintendents have of late increased the diameter of their empty bobbins without considering the spooling cost. When the diameter of the empty bobbin is increased there are less layers on the bobbins with more weight. It will also be proved that the spooler tenders make just as many piecings and work as hard with a much smaller production. Again, if a seven-eighths inch

bobbin is used with a one and one-half ing diameter ring for the warp, the spooling cost is also increased. Of course, the writer is aware that most spinners will tell you that it is wrong to

INCREASE THE PULL

on the yarn on the ring frame. The writer is willing to admit all this, if conditions in preceding processes are like those found in the ill-managed mill found in the second chapter of these articles, but if conditions are the same in the well-managed mill, the yarn delivered at the ring frame will be sufficiently strong to stand the pull so as to make a cylindrical compact bobbin, that will run well on the spooler and also reduce the cost. If the reader is a mill manager he should visit his spooling room, and it is safe to say that he will find very few bobbins that are filled throughout the length of the traverse, but instead he will find some a quarter inch, some one-half inch, and some even one inch from the shoulder of the bobbin to the coils. All mill men know that the above defect increases the spooling cost, still in most all mills visited by the writer, the spooling cost is affected by the above defects, and the writer is astonished that it is allowed to continue.

Almost all spooler tenders are paid by the pound; that is, they are generally paid so much per 100 pounds, and so many pounds of yarn and bobbins are put into a box and evenly filled, and are called a certain number of pounds, and every time a box of yarn is given to the tender, the yarn man has a punch, and punches a hole in the tender's ticket. At the end of the week the number of boxes are totalled into hundreds, and this amount is multiplied by the

PRICE PER HUNDRED,

which constitutes the tender's wages.

If such defects reduced the amount of the labor, an excuse could then be offered that it was done to help out the tenders in order to get more help, and the best of help. But such is not the case, and besides it reduces the production in the ring spinning room, owing to the extra amount of doffing that the above defects necessitate. Let us study conditions as we find them existing in our cotton mills today. We find in one mill, where the tenders are paid less per hundred getting a bigger wage than those who get more per hundred; they work fewer hours and get more pay. Besides, we find in the mills where they pay less per hundred plenty of help, and good help, too, while on the other hand the mills that pay more per hundred are short of help and they are of a much poorer class.

It is all in the management, and if you are a mill manager or overseer you must admit that the writer is correct in his assertion that such conditions are found in all poorly managed mills. Let us picture in our mind a spooler tender running 100 spindles.

The bobbins filled with yarn received from the ring room are to be properly constructed; that is, the coils are laid as close as possible, from one shoulder of the bobbin to the other, or, in other words, the greatest possible length of yarn is wound upon the bobbin. Let us now assume that the bobbin holders

ARE ALL EMPTIED

and the tender begins the day's work. She puts the first bobbin in the first holder, and with the aid of the knotter the end is pieced in an instant, and so on until she has all of the hundred spindles in operation. The great length of yarn on the bobbin will give the tender ample time to put a bobbin in each holder and piece them and besides have a little time to fix the amount of bad yarn that may have been found in the previous box. On the spooler, as on other machines when every part is in operation, it is making money for the plant.

On the other hand, let us picture in our mind that instead of having well constructed bobbins, as in the above case, they are soft and not filled properly, which decreases the length of the yarn on the bobbin. Picture in your mind, as in the above case, that the tender begins the day's work and

all the holders are emptied and she, too, has a knotter. The short length of the yarn on the bobbin will not allow the tender time enough to reach the last spindle before the bobbin in the first holder is emptied. Besides, owing to the bobbins being soft and not perfectly cylindrical, the yarn will break, as was explained, which calls for still more piecing, and this takes up the time necessary to fix the bad yarn. So we have spindles idle at all times, good yarn sent to the rope works, due to the

COILS BEING IMPROPERLY LAID

on the bobbins and the tender working harder with less pay.

When the tenders are unable to supply the spooler spindles with yarn, in most cases the ring frames must be stopped on account of a shortage of bobbins. Such a condition exists at this writing in a certain mill, and the writer has seen as high as 64 sides stopped on account of the above defect.

All mill managers know that the above conditions existing in any cotton mill are expensive, but even this is not equal to the extra cost in the spooling room. A certain overseer, by changing travellers and by increasing the length of the traverse on the ring frame, put 3,000 additional pounds through the spoolers, unknown to the help. In the above case, the spooling cost was, of course, reduced. This overseer should have counted the number of bobbins in a spooler box before and after making the change. This would be more convincing to those who have a short length of yarn on the ring frame bobbins, as it increases the amount of wood to be weighed at the spooler instead of yarn. It must be admitted by all mill men that the piecings and knots in the yarn are increased as the length of the yarn wound on the bobbin is decreased. It will be found, also, that where the tenders are unable to supply

THE SPOOLER SPINDLES

with yarn they are continually asking for a rest. The writer has in mind a mill that has of late made many changes in overseers of spooling.

One overseer instead of increasing the length of the yarn on the bobbins increased the speed of the spindles from 700 to 850 revolutions per minute, with the result that he, too, lost his job. What he should have done before going ahead was to study conditions. He should have seen that there was very little to gain in speed when the tenders were unable to supply the spooler spindles with the speed at 700 revolutions per minute. To give the reader an idea of the extent to which some mistakes are made in some cotton mills, the following story is given. It seems that the manager of the mill was dissatisfied with the amount of work produced, and he ordered the overseer in charge to lag the pulley with leather. The manager made a mistake in his man, for the overseer knew his business, and instead of lagging the driving pulley, he lagged the driven pulley. The production was greatly increased, which, of course, satisfied the manager, who for a time felt proud of the fact that such a thought came into his mind, but the reader can imagine what he thought when he later examined the pulleys. No. 156.

CLVII. SPOOLING.

The bobbins as they come from the warp spinning frames are placed by the spooler tender in the bobbin holder, the end of yarn being passed under a swinging arm composed of wire. The end is then pieced to the end on the spool, and inserted in the thread guide. The bobbin as it is unwound in the bobbin holder is made to revolve at great speed, and for this reason, the curved plate on which the bobbin is made to revolve is then made wider than formerly. Still you will find at this writing that many mills which are crying shortage of help are running their spooler spindles as high as 900 revolutions per minute, with a narrow curved plate All mill managers, in order to improve their spooling department, have a choice—either to discard their narrow curved plates or run the spooler

spindles slow. When the spooler spindles are run over 700 revolutions per minute with a narrow curved plate, the swinging arms will allow the bobbins that are two-thirds or more unwound to escape from the holder, and for this reason, the spooler spindles should not revolve over 600 revolutions per minute. Spooler spindles should not revolve over 700 revolutions per minute even if the spoolers are equipped with wide curved plates. When spooler spindles are run over the above stated speed it will be found to be more of a loss than a gain, for reasons stated elsewhere. From the above it should be obvious to the reader that even if the manufacturers have a choice to improve the spooling in the manner stated, the wide curved plates and the spindles running 700 revolutions per minute will better conditions for the spooler tender and give a larger production.

All practical mill men know that the spooler tenders will open the thread guides, and for this reason, the overseer in charge should examine them often. You will find even overseers that will open the thread guides themselves in order to put through a larger production, and at the same time, increase the spooler tender's wages.

There is no other defect more detrimental to the

QUALITY AND APPEARANCE

of the cloth produced than to have the spooler guides opened more than one-half over the diameter of the yarn being run. The writer gives the following rule to set spooler thread guides, and although many overseers may say that the setting is too fine, it will be found that, if put into practice, the cleanest and finest quality of cloth will be produced. It is first necessary to find the diameter of the yarn run. Rule: To find diameter of cotton yarn, find the number of yards per pound in the counts run and extract the square root of the number and deduct one-eighth from the quotient. This gives the denominator of a fraction having one as its numerator, which indicates the diameter of the yarn. Example: At what size gauge should the thread guides be set when running 30s yarn. Solution: 840x30 equals 25,200 yards. The square root of 25,200 equals 158x .92 equals 145.36. 145.36 divided by 2 equals 72.68. 145.36 minus 72.68 equals 72.68 or 1-73 inch gauge. Is it not much better to use the above method of setting the thread guides and prevent bad piecings, lumps, neps, etc., than to have them opened too much and allow the above defects finding their way to the cloth. With the above method of setting thread guides, if the carder allows the flats to be set over 10-1,000 gauge away from the cylinder, or run a poor licker-in, you then have trouble in your spooling, and instead of opening the guides or allowing the spooler tenders to open them, the trouble in the preceding processes should be remedied. All practical mill men know that the above is the chief defect in all cotton mills if not given proper attention. The writer has seen conditions so bad in some cotton mills that the defects in the yarn referred to above were so numerous that they could not be counted when standing in front of the warper. That the above is true no experienced mill man can deny.

PROPER CARE.

Many mill managers will, instead of insisting on giving proper care to the thread guides on the spoolers, demand that the overseer make the weavers save all defective places in the yarn and hang them on the gas pipes to show up other departments. The above is a poor way to manage a mill, because, in the first place, it creates a lot of excitement, and besides, it creates a certain amount of friction between the overseers of the different departments. It has often been noticed that many a cotton mill remained in the old rut, simply because the overseers did not pull together. The above common occurrence is, figuratively, what happens in a cotton mill where the overseers do not pull together.

In all cotton mills, it is of greatest importance to have overseers pull together. It is too often we hear the remark made that the overseers of a certain cotton mill are not pulling together, and a change in the management is expected at any moment. These stories vary in intensity from very mild cases to such serious eruptions that the state of affairs becomes almost unbearable to those who come in contact with the actual conditions. When such conditions of affairs exists, it savors of much hard feelings, and the good work that might be done suffers for want of the really good natured zest that should be within every overseer.

It, therefore, follows that anything which interferes with the progress of the plant is wrong and out of place, and, instead of trying to show up a man, the manager should see that the parts on all machines are properly set. It is always found where such a dilemma exists that the reason is simply because the superintendent is not a practical mill man. The writer has in his mill life seen the overseer of weaving and the overseer of the cloth room have very heated arguments many times over existing condition, and the superintendent, not being a practical mill man, when told of the situation, simply answered, let them fight it out.

The writer will, of course, admit that in some mills the methods of setting the

SPOOLER GUIDES

given above is an impossibility, owing to the conditions in the preceding processes being so bad. The thing for all mill superintendents to do is to definitely lay out the work to each subordinate, but it takes a practical superintendent to do this. A superintendent should draw everything to the centre of the company's welfare, and only when this is true will you have proper conditions throughout the plant. When knots, lumps and other defects in the yarn are allowed to reach the loom, as a rule they are unable to pass through the harnesses and reed, owing to the chafing of the harnesses and beating up of the reed; consequently, these defective ends are broken, and the defective place, being heavier than other parts of the yarn, will swing over and get entangled with other warp ends, and a number of other ends are broken, or what is termed a smash is the result. A thread guide consists of an upper and lower plate, and the opening between these two plates can be regulated according to the size of the yarn being run, employing the method already given. The primary object of the thread guide is, of course, to guide the yarn from the bobbin in the bobbin holder to the spool. For this reason the practice of removing leaf, dirt, and other matter referred to above with the thread guide is overlooked by many overseers. Most overseers of spooling will defend themselves when their guides are found opened too much, with the argument that they do not believe in the practice, since this matter should be attended to at the earlier processes.

There is no doubt that the above argument holds good, but it is also true, that it is impossible to have the work in the earlier processes always perfect, and for this reason, the spooler guides should be used as a protection against such defects that are liable to occur at any time in any cotton mill. Again, it should be seen that when the yarn is full of defects, if the spooler guides are not properly closed, the work will gain much headway in after processes before the defects are discovered.

No. 157.

CLVIII. EFFECT ON THE CLOTH

When a large amount of defective yarn is on the beams, it must be woven, and the result is that the cloth produced must be put into seconds. This is very expensive, especially in fine goods mills. The above is a good point for all mill men, and it must be admitted that if the guides are set in the manner de

scribed above, the result will be a great saving for the mill, and will cause more trouble in the spooling department, but it will be found to be a telltale of the conditions in the preceding processes. To save the initial cost, a great mistake is sometimes made by many mill men, as when making specifications of spooler guides, they equip their spoolers with guides so that if the slot becomes clogged, the lower jaw cannot be tipped slightly to the front, in order to expose the edge so that the tender may remove any lint with ease. This is an important point and one that will cause much trouble, as large bunches will collect in the slot and follow the thread. These bunches are flattened at the slasher and are given a much larger appearance.

KNOTS AND BUNCHES

in the yarn are a great drawback to good weaving, and for this reason, all spoolers should be equipped with guides so that the lower jaw or blade can be controlled by a hidden spring, which may be compressed so as to open the slot temporarily for the removal of any matter that may collect.

The only fault that can be found in the very latest guides is that the adjustment for changing the width of the slot should be made more difficult, so that the space of the slot could be only affected by the overseer or by anyone in charge that would have a certain particular tool for effecting the fastening device. It is too often we find when visiting mills that the overseer when asked will tell you that his guides are all properly set, and upon examination you will find them set differently. The overseer will then tell you that it was only a short time ago when the guides were all properly set and that the tenders themselves changed the setting so that all bobbins would run out without any breaking. Many will tell you that a good remedy for such a practice is to discharge the spooler tender, but this cannot always be done, because in the first place, a tender may change the setting of the guides and then sever her connections with the mill, and in the second place, help is not always plentiful enough to carry out such a plan.

The above is a trouble that many spooling overseers are experiencing at this writing, and it must be said that they are not wholly to blame; because even if the overseer in charge is continually watching the thread guides, this practice is carried on to such an extent in some mills that as soon as such tenders are employed (even in fine mills), the first thing they do is to open the thread guides, and a day or two will pass before this is discovered, because no mill manager can expect an overseer of spooling to examine the spooler guides every day.

The only remedy for the above defect and one which would be welcomed by many overseers of spooling, is to make the fastening device for the adjustment more difficult.

The spooler guides when properly set are also valuable in determining the proper amount of twist in the yarn, and again, a lot of trouble is prevented in after processes. All experienced overseers of spooling have the spooler guides properly set to avoid trouble in after processes. They will tell you that by having the guides properly set, they can tell in an instant when a new lot of cotton comes in and if the proper number of turns are not put in the yarn.

On the other hand, if the guides are not properly set, a large amount of soft twisted yarn reaches the warpers, and the trouble is much greater because the yarn has to unwind a much heavier spool, and at a much greater distance. For the reasons stated above, it should be seen that much defective work can be prevented throughout the mill by using the best of

CARE AND JUDGMENT

in setting the spooler guides. Another mistake that is made by many mill men when equipping a mill is in buying all the

machinery from one machine company, simply because they wish to have the same kind of machinery in every room. Such a practice is not defensible when better machines can be procured by purchasing them from different companies.

One kind of machinery throughout the mill is bought as a rule by those more or less new to the cotton mill business, and for this reason they are apt to be influenced, more or less, by the persuasions of personal appeal. Another defect that is found to exist at this writing in many spool rooms is in the use of the old wooden boxes. Even if these boxes are raised they are altogether too low, owing to their great depth. The above defect can be traced as one of the causes for the shortage of help in those mills, because the help have to stoop so low that they are continually asking to go out on account of a sore back. Again, spooler tenders will, as a rule, flock to the spooling room equipped with steel creels and boxes. The reason for this is because the steel boxes are not very deep, and besides the spoolers are so constructed that the height of the machine can be adjusted to suit the tender by means of adjustable legs in the frame. This is

AN ADVANTAGE

over other spoolers, because, besides helping the motions required in spooling, which are very fatiguing, shorter help can be employed with such constructed spoolers than on any other kind of work. What should be done in those mills which are now using old wooden boxes is to cut away about one-half of the box, thus decreasing its depth one-half, and then raising it as high as possible. Put more work upon the yarn boy and shorten the spooling motion, or in other words, instead of having a box that will hold two or three distributing boxes have the spooler box so that it will only hold one. The practice found in the mills where these old deep wooden boxes are used is that the yarn boy will dump two or three boxes in each spooler box, and then he has a layoff so to speak. The conditions in a spooling room vary much in different mills.

For instance, you will find in some mills that the spooler tenders must fix the bad yarn they receive among the good yarn, while in others, a spare hand is allowed to fix the bad yarn. This is

VERY UNFAIR

to many overseers, because, owing to conditions being so unequal, the overseers having the extra hand, will take off a large production, as they always have plenty of good help.

Let us reason together and examine carefully the above unfair conditions existing at this writing in many mills, and see the advantages and disadvantages that such unfair conditions will cause. Such conditions are found to exist even in the same plant. In the first place, it must be admitted by all mill managers, that there is not enough bad yarn made in any spooling room to take up the time of an extra hand. So we find that in those mills where an extra hand is allowed, the spare hand is spooling more than one-half the time. Secondly, it must be admitted that the extra boxes run through by the extra hand increase the production, and these extra boxes are distributed among the other tenders, thus increasing their wages for less work, because in the spooling that has no spare hand, the spooler tenders are called on to fix the bad yarn and besides they get no extra boxes. Can anything be more unfair than the above? You will hear manufacturers inquire from one another, "How much do you pay per box or per hundred pounds for your spooling?" The answer will be perhaps from the manufacturer that has no spare hand in his spooling room, and he answers, .095 per box. The first manufacturer will then say, (unconscious of the trouble he is causing for the overseer), "Why we only pay .09 per box".

The writer is willing to admit that each manufacturer is not aware himself of the conditions existing, be-

cause such work is done by his superintendents. But it should be seen from the above that the spooler tenders receiving only .09 per box, are much better paid than those receiving .095 per box, owing to the extra amount of boxes allowed them at the end of each week. No manufacturer wants to pay more wages than other manufacturers for the same work, and for this reason, the manufacturer quoted above as paying .095 per box without a spare hand, will on reaching the mill send for the overseer of spooling, and simply tell him that he has just learned that they are paying more per box than other manufacturers, and that he must come down to this price. He is also told that he can go to the mill where they only pay .09 per box and be convinced himself. The overseer may do this, and, he himself, not knowing existing conditions must admit on his return, that he is paying more per box. Consequently, the price per box is reduced, and the result is a continued shortage of help. Again, the overseer is blamed for the

SHORTAGE OF HELP,

because the treasurer or agent conceives the idea that his overseer is on the same basis as the other overseer, and in most cases he loses his job. A change of overseers in such a managed plant is often made, not only in the spooling room, but in the ring spinning and carding room as well. The writer, himself, has been a victim of such scheming. It must be admitted that the help themselves are informed of such conditions and will, of course, flock to the spooling room where they get the most pay for less work, and for this reason, one mill has an abundant amount of spooler tenders, while other mills which are paying more per box are continually short of help. When a change has been made in the overseer of spooling, and conditions show no improvement, the spinner is next changed, because where there is a shortage of help, you will find dissatisfaction, because they know that owing to the shortage of help, they are masters of the situation, and for this reason they are continually finding fault with the work, and consequently the spinner is discharged. Then, of course, conditions do not improve and the carder is next, and so on, which proves that the above condition is one reason why there are so many changes of overseers in some corperations.

For the above reason, the writer has seen as much as thirty frames stopped in some mills. Besides you will not find a homogeneous service where such conditions exist, owing to the friction that such conditions cause between the overseers and superintendent.

What manufacturers should do when comparing prices of any department is to compare the number of day hands and conditions as well. If the reader is a practical mill man, he can see that when a number of frames are stopped it is a

WASTE OF MONEY,

because the fine speeder bobbins are soon all filled, and consequently the speeders are stopping for bobbins, and the back work piles up and the machines in the preceding processes must be stopped. As is well known the help on all machines preceding the fly frames are paid by the hour, and it is a great expense when these machines are stopped. The above conditions increase the cost in each department throughout the mill, because the weavers are continually waiting for warps, which greatly reduce the production of the weaving, and the cost per pound is found to be also higher, because in the weaving, as in other departments, the day help time is running on. Let us stop and reason here and examine the above conditions that are found to exist in many cotton mills, and see what a difference of about seven dollars a week will make in the spooling department.

From what we have said above, it can be seen that the loss to the mill is in some cases twenty times greater

than the wages of the extra hand. The writer does not advocate an extra hand, because he brands the above practice as dishonest. The overseer of spooling should, when there is no work for the extra hand, lay that hand off for a day or two, until there is enough bad yarn to keep that hand busy, or if that hand is put on spooling, the number of boxes which are put through by this hand should be credited to the extra hand, and the number of hours that this extra hand has worked on spooling should be deducted from the day pay. In this way, the overseers would all be on more of an equal footing, although the overseer having the extra hand would, of course, still have the advantage, because when spooler tenders do not fix their own bad yarn, they are more able to put through a larger amount of boxes, thus increasing their pay.

There are many overseers of spooling suffering from the above conditions at this very writing, (especially in the Fall River, Mass., mills), and the only fair thing to do for these overseers is to take away this extra hand, and put all overseers on the same basis by paying the same price per box. The above is not only unfair to many overseers, but it is also unfair to the stockholders of mills where such conditions are found to exist, because idle machinery in any mill is a waste of money. No. 158.

CLIX. SPOOLING.

Spooler spindles resemble the ring frame spindles in construction, that is, they consist of a blade that is supported by a base in which the spindle revolves. The blade carries a whorl, and like the ring spinning spindle, is driven by a band that passes around the whorl and cylinder. The spooler spindle is larger than the ring spinning spindle, and for this reason is harder to drive, and this, aided by the weight of the spool, which is considerable, makes the consumption of power much greater. For this reason a heavier band is used, and, as a rule, one band drives two spindles. The inside casing differs much from the ring spinning spindle, the reason for this being that it is very seldom run over 700 revolutions per minute. The spooler spindle base is constructed more to support a heavy spool, the speed not being considered. The chief aim is to make the spindle very rigid and strong, which is accomplished by the use of sheet metal plates which extend the full length of the spooler below the rail. As was stated elsewhere, a high speed on any spooler is very detrimental to after processes, and a slow speed on a spooler tends towards a stronger and more elastic yarn with fewer knots. Fewer knots in the yarn mean fewer knots in the warp, and fewer knots in the warp tend to increase the production of the weaving, and besides better goods are made. We recommend a spindle speed of 600 to 700 on all spoolers in print cloth mills, with plenty of

SPOOLER SPINDLES

to do the work. Spooler spindles may be banded in several ways, but the best and most popular one is as stated above.

Some mills band the spindles so that one hand will drive twelve spindles, but this method is rarely found. The chief defects in this method of banding are: 1. Every time a band breaks it necessitates the stopping of twelve spindles, and they may be stopped for a considerable length of time, which happens often, owing to the section hand being busy elsewhere. 2. The band only circles about one-quarter of the whorl on the majority of the spindles, and for this reason the bands must be much tighter, and changed when slightly slack.

The only point to be considered in the first method of banding given above is to make sure after banding the spindle that it revolves in the opposite direction to that of the hands of a watch. Not considering the above is a mistake that is often made when banding spooler spindles, and it causes the ends when being wound to pass to the right-hand side of the spool, which holds the ends continually on one side of the slot, thus making the pull on the yarn greater.

Owing to the spooler tenders being usually paid by piece work, they are anxious to put through as many boxes as possible, and for this reason they generally

PREFER THE KNOT TIER

known as the Barber knotter. The knots made by the knotter have no loose ends, and besides, the knots are not so large. When the ends are tied by hand, they are tied as rapidly as possible, and for this reason the knots are more faulty. There are several ways in which a knot tier can be used, the most popular one being to wear it on the left hand and operate it with the thumb. The ends from the bobbin and spools are drawn over the top of the tier and a quick movement by the thumb forms the knot in a second.

It is customary for the best spooler tenders to gather the ends of five or six bobbins and spools before doing any piecing, and then the ends are pieced quickly one after another.

It must be said that if the knotters are given proper care they are a great aid to the weaving, and that a larger and better quality of cloth can be produced. When knotters are not used, the overseer should always demand that the spooler tenders make a weaver's knot, and also see that the knots are tied as small and neat as possible.

No. 159.

CLX. THE TRAVERSE.

As on the ring frame, the traverse on a spooler should be given proper attention. This is the chief fault that is generally found on spoolers, because if the traverse does not fill the spool from shoulder to shoulder, soft places at both ends will result. On the other hand, if the traverse runs too high, with a proper length traverse, a hard place is formed at the top of the spool and a soft place at the bottom, or if the length of the traverse is correct and the traverse runs too low, a hard place is formed at the bottom of the spool and a soft place at the top. Once the traverse is properly set, very little trouble is experienced on a spooler, if the lifting rods are well lubricated and kept free from dirt. Defective spools are generally caused by the lifting rods sticking, which is due to neglect. For the above reasons, when winding the yarn from the bobbins to the spools the chief object should be to wind the yarn on the spool in such a manner that when the spool is filled its centre will be larger in diameter than either of its ends. When spools are so constructed, they hold more yarn, and unwind better at the warper with

LESS BREAKAGE.

A barrel-shaped spool, as it is termed, is attained by means of what is known as a mangle gear. The mangle gear is composed of two rings joined together by pins that mesh with the gear on the end of the shaft extending along the centre of the frame and directly under the cylinder.

Cast on the hub of the mangle gear is a gear that meshes with a quadrant fastened to a shaft that indirectly imparts motion to

THE LIFTING RODS.

It can be seen that as the mangle gear has its direction changed or its motion continually reversed, the quadrant motion is also reversed and gives an alternating up-and-down movement to the arms and levers which acts correspondingly upon the lifting rods. A spooler differs from a ring frame in regard to the rail movement. On a spooler, the lifting rods are so arranged that when the rods are down on one side of the frame they are up on the other side, so that one side will tend to balance the other, thus greatly lessening the amount of power necessary to move the rail. The question has been often put to the writer why such an arrangement was not adopted to balance the rails on the ring frames. No doubt such an arrangement would lessen the amount of power necessary to drive the ring rail, and such change would be welcomed by overseers and manufacturers, because such an arrangement would prolong

the life of the builder. But it should be remembered that on a spooler the spools are doffed separately as they fill, the spooler not even stopping, while on the ring frame the bobbins must be doffed together, and at the same time both sides of the frame must be doffed together also. For this reason, the rails on each side of the ring frame must be down together. The adjustment found at the spooler for balancing the rail could not be very well employed on the ring frame. The chief objection would be the loss in production in doffing only one side of the frame at a time. The mangle gear is eccentric, and from its contraction the

BARREL-SHAPED SPOOL

is attained.

A little reasoning on the part of the beginner will show that the farther away the teeth are arranged on the mangle gear the larger the gear, or in other words, if the teeth are six inches from the centre of the mangle gear, it may be said that the pinion is driving a gear 12 inches in diameter, while on the other hand, if the teeth are eight inches from the centre of the mangle gear, it may be said that the pinion is driving a gear 16 inches in diameter. Again, if the teeth in the mangle gear were arranged circular and the speed of the pinion gear remained constant, the speed of the traverse rail would also be constant on both up-and-down traverse and at every part of the traverse; thus, the spool produced would have the same diameter throughout the length of the traverse. So, in order to give this barrel shape to the spool the pins that form teeth are arranged so that every pin excepting the end ones will be at a different distance from the centre of the mangle gear. By such an arrangement, the traverse rail, and consequently the thread guides, move more slowly while passing the central part of the spool than at the ends, thus laying more yarn on the centre of the spool which gives it its formation. No. 160.

CLXI. SPOOLER DEFECTS.

A few calculations on spoolers given by text books and textile schools are the spindle speed, change gear and production. We have already explained the reason for not figuring the production, instead, giving a practical accurate method.

The spindle speed should not be figured. It should be found in the same manner as finding the spindle speed on a ring frame, and the same device should be used. The only calculation is finding the change gear. This is found by proportion, as the length of the traverse on a spooler is in direct proportion to the size of the gear. If a 10-tooth gear gives a 5-inch traverse, what gear will give a 4-inch traverse?

The beginner should see at a glance that the gear must be smaller in order to give a shorter traverse, so we have 10x4 divided by 5 equals an 8-tooth gear. If we want to find the length of traverse, a certain gear will give, we simply reverse the above. If a 10-tooth gear gives a 5-inch traverse, what traverse will an 8-tooth gear give? 5x8 equals 40 divided by 10 equals a 4-inch traverse.

ONE BAD DEFECT

that exists in many spooling rooms at this writing is in the manner of marking spools. You will find some mills have the spooler tenders mark with chalk all spools that they fill, while other mills use spools with different colored heads, one color always being used for a certain spooler tender, or for a certain count. Having spools with heads of different colors seems to answer the purpose better as far as mixing the yarn is concerned. But it often happens that when a large order is received on a certain number of yarns, these spools must be separated, and the spooler tender knowing that the amount of bad work cannot be located will work in a more careless manner, her chief object being quantity. Chalk gives very poor service, owing to it being rubbed off so easily, and this causes spools to be found here

and there about the rooms without a mark.

The warper tender will, instead of taking the trouble of having the yarn sized, put such spools in and run them with another yarn which differs much in diameter. Again, if a spooler tender makes a bad spool, she will not chalk such spools, but instead, will come in to her work earlier in the morning and distribute such spools about the room, so that her bad work can never be traced back to her. The above is a practice that is

WORKED TO THE LIMIT

in some mills. Again, when chalk is used, it is very unhandy for the tender to hunt up the chalk every time a spool fills. The only and best way to overcome the above defect, and one which will save a lot of trouble, is to give each spooler tender her own box, and also a colored box. At the end of each day's work, the boxes should be run into a small room until morning, or have a cover on each box that can be locked over night. In this way, each tender is forced to put all full spools in their proper place, and thus is unable to rid herself of her bad work by coming in earlier in the morning. Again, in this way, the number of the yarn can be changed on the box simply by tacking a ticket or marking the number of the yarn on the box.

The chief defect found in the management of most all spooling rooms is dirty spindles. The writer has seen spindles so dirty and dry that they could be heard squeaking here and there about the spoolers. The writer is willing to admit that it is almost impossible to prevent the yarn and waste from collecting on the spindles, because the yarn will, from one cause or another, ride under the lower head of the spool and be wound around the spindle until the end breaks or is discovered by the spooler tender. Spooler tenders, as a rule, do not bother with the yarn that collects on the spindles, and for this reason, the overseer should give this matter his closest attention, and have

SPINDLES CLEANED

from time to time, at least every week. Spoolers, like other machines, are known by the gauge, and not by the length, and on the spooler, as on other machines, it is a poor practice to adopt too narrow a gauge because it bothers the spooler tender more or less, and besides, it makes it impossible to run a large spool when changing to coarser yarn. The best way is to make the specifications so as to have a gauge of 4¾ inches, which is the most common one. The most misunderstood defect on a spooler is the vibration that is found to exist on the spooler spindles.

The writer has in mind, a superintendent who bought a full set of new spooler spindles in order to reduce the vibration on the spindles. The only way that the vibration on spooler spindles will ever be stopped will be accomplished when the arbor for the spooler spool in the spooler is so constructed that the arbor will revolve with the spool. This vibration found to exist on spooler spindles is a defect which sets most of us thinking, with the result that we have a better fitting bobbin on our ring frames than ever before.

It was discovered long ago, that owing to the spools revolving on the arbor in the warper creel, the inside surface in contact with the arbor was badly worn on some spools, and at the same time, was very uneven, while on all other spools, a slight wear is found to exist. This is the cause of the vibration on the spooler spindles. What the superintendent quoted above should have done, and it would have been much cheaper, was to have bought new bobbins instead of new spindles. All practical overseers of spooling do not notice

SPINDLE VIBRATION,

because they know full well that the defect is in the spool, and not in the spindle. As stated, when it was discovered that a slight wear on a

spool would cause such vibration, the most of us turned our attention to the ring spinning bobbins, and it was soon discovered here also, that in order to stop the vibration of the ring frame bobbin, the recess at the top of the bobbin must at all times fit the top of the spindle blade snugly. The cheapest way to overcome spindle vibration is to have a standard spindle, and all spools that vibrate should be tried on this standard spindle to ascertain whether the trouble is in the spool or in the spindle. However, as stated above, the trouble is seldom found to exist in the spindle, unless found very dirty, but as the cause may be in the spindle, it is a good practice to try all spools that give trouble. This will preclude the possibility of throwing away good spools.

The above trouble is seldom, if ever, experienced in cases where the yarn is wound onto spools from cops. The reason for this is that, owing to the spool unwinding the coils from the cops only, there is very little tension on the yarn, and the position of the spool on the spindle is not so liable to be changed at every revolution. It should be seen that vibration is caused by the bobbin or speed not fitting the spindle properly, and in having its position changed at every revolution by the pull of the yarn that always exists on one side of the spool or bobbin when the tension on the end is great.

WHEN COPS ARE USED

on the spooler, instead of placing the cops in the bobbin holder, they are placed on spindles having a perpendicular position, and the yarn is carried through a guide which resembles the thread guide on the ring spinning frame. As stated, owing to the lack of tension in this method of spooling, the coils on the spools are not laid as close as they should be, and consequently, the amount of yarn wound on the spools in this system is much less than when wound from bobbins in the holders. In order to lay the coils on the spool closer, more tension is put on the yarn by adjusting the thread guide on the traverse rail to occupy an angular position to that of the traverse rail. The above can easily be done, as the thread guide is setscrewed to the traverse rail, and is thus capable of being given any desired position.

It is just as handy for the spooler tender to insert the end in the slot when the guide occupies an angular position to that of the shaft, and it will be found that the spools will take a longer time to fill. When the spooler spools are soft, in some cases, enough yarn cannot be run on the spools to run the intended number of raps on the beam, and for this reason, a larger spool is ordered. Larger spools are, of course, much heavier, and with the extra amount of yarn, the pull must be greater in order to unwind the yarn from the spool, and again, more trouble is experienced, because, owing to the coils not being closely laid, the pull on the yarn causes the end to sink in the surface of the spool instead of turning the latter. Consequently, the end breaks and in most cases it is hard to locate on account of having sunk in the surface of the spool. These spools are taken out, and in order to locate the end, a coil or two is broken on the surface of the spool, and then laid under the end of the section beam shaft, and the ends are passed over the shaft and allowed to wind thereon until the sunken end is located.

The above will happen in all spooler systems, but the cause is

LACK OF TENSION

on the yarn. The guides being opened too much will cause the above trouble. Another method that can be employed to create tension on the yarn when cops are used is to have the yarn run over a friction flannel situated between the cops and the spools. It will be found that the best results will be obtained by regulating the tension by the position of the thread guide in either systems. When starting a new spooler, see that all parts are freely oiled, and make sure that the lifting rods are free, then having the pinion gear in its

proper position, find the difference between the number of teeth on the stud gear and the number of teeth on the segment, and set the stud gear from the end of the segment one-half the difference between the number of teeth on the segment and on the stud gear. Example: if the segment contains 30 teeth and the stud gear 20, then when the mangle gear and stud gear occupy the proper position or at the point of reversing, have the gear on the stud 30 minus 20 equals 10 divided by 2 equals 5 teeth from the end of the segment. Then bring the bottom traverse rail on one side to occupy a position one-sixteenth of an inch above the bottom heads, and the top traverse should be the same distance below the top heads of the spools on the other side. At this point, if the traverse rail is too high, both at the top and bottom points at which it reverses, this can be adjusted by dropping the rods until the traverse rail assumes its correct position.

Now before setting, the other side of the rail just set should be brought at the other end of the spool, and if found to be correct, the rail on the other side will occupy the position when the first rail was set and by setting it at the same distance from the head of the spools, they should have the same relative position. When the parts of a spooler are properly set, the studs in the lever slots should be at the same point and the traverse rail perfectly horizontal. No. 161.

CLXII. WARPING.

By most mill men, warping in a cotton mill is not considered an important feature of the ordinary method of cotton-warp preparation, and that is where a great mistake is made. The writer will prove that with clean even yarn careless warping makes the finished cloth unmerchantable in many mills. Warping in a print cloth mill is known as beam warping, the class being dealt with at present. There are, however, several classes of warping, that are divided according to the manner in which the yarn is treated, which will be explained later.

The object of the warper is to unwind the yarn from a large number of spools so as to form a sheet which is placed on a beam. As stated above, if no attention is given to the warping, even if the yarn is clean and even, the cloth can be given a bad unclean appearance by not knowing how to warp, or by careless warping

To prove the above, let us suppose that the spooler tenders are not filling the spools evenly. It is obvious that the spools having the shortest length of yarn when unwound in the warper creel will unwind the yarn closer to the barrel of the spool. All

PRACTICAL MILL MEN

know that the spools on a warper are all pieced together, and that on all spools the yarn nearest the barrel is full of knots. So it can be seen that when a spool is not properly filled on the spooler a number of knots are unwound. Very often when the yarn is unwound so low on the spool it gives the cloth a bad appearance. Even one thread gives bad results, which are multiplied by the number of spools not properly filled at the spooler. A warper tender can not be held responsible for such work, and for this reason they take little notice of the spools when the yarn comes from the spooler, unless, of course, the spools are so small as to run out before the beam is full; however, this seldoms happens, unless the number of raps on the beam are increased for a new style of cloth. The overseer of spooling should insist that the spools on the spooler be doffed at a uniform size, so that when the spools are unwound they will all be of one length, and the knots found near the barrel of the spools are not unwound when the yarn is even, and the few knots that will find their way to the beam will be from the spools where the yarn is very heavy and of a shorter length, which is impossible to avoid in any cotton mill. When

the beam on a warper is filled it should be doffed and before the spools in the warper creel are changed, which is termed doffing, the warper should be run so as to run off the majority of knots made by the spooler tenders on the first piecing; however, we do not advise one to

RUN THE WARPER

any more than to the amount of two layers on the spools in the warper creel. By doing so at every doff it prevents the spooler knots from accumulating between the point when doffing and the barrel of the spool. Then the spools should be doffed and the warper should again be run long enough so as to run all the knots made at doffing time down on the empty beam before the projection on the grooved barrel is set.

It will be found in almost all cotton mills that instead of employing the above method, that as soon as the beam is doffed the warper tender will while the beam is being doffed, doff the empty spools also, so that in this way the spooler knots remain on the spools, and the amount of knots either increases in the cloth or on the spools, however, it is safe to say that these knots do eventually find their way to the cloth. Let the mill man study the above, and he will finally admit that even with very clean yarn, the above method will give the cloth a bad appearance, that is, as a rule, blamed on the preceding processes. Again, you will find that some mills making the

FINEST OF YARNS,

allow the ceiling, hangers, and pulleys to be cleaned while the warpers are in motion. They will even allow the warper tenders to use blowers that scatter the fly all over the spools. Brushing down, as it is termed in a print cloth mill, and blowing, is certainly carried on to the limit when the warpers are in operation in most cotton mills, and as stated, the spinner or carder is blamed for the unclean condition of the yarn.

No. 162.

CLXIII. OPERATION.

The construction and operation of a warper is so simple, that for this reason very few mill men know that by neglecting its operations the yarn can at this stage be made defective. Any practical man knows where the fly has collected by examining the thread when the strand is pulled from the cloth in the cloth room. He knows that if the fly was collected on the roving the fly will be twisted with the fibres in the cross-section of the strand and that it is impossible to slip the fly over the thread. On the other hand, if the fly has collected on the thread after the strand has passed the drawing rolls on the spinnin frame, the fly will be found to be twisted around the thread, but can be slipped over the thread. When the fly has collected on the thread at either the spoolers or warpers, it will be found to have a flattened appearance owing to having passed the squeeze rolls in a humid condition and starched and dried in that condition. Here is where the practical superintendent counts and saves the mill many dollars, because the practical man can not only point out where these defects in the yarn are made, but he also knows the cause and the remedy, while other superintendents do not even know the difference between a bunch of fly or yarn and a knot. It must be admitted that as the spooler spools are run down to a certain place at each set, if the spooler

KNOTS ARE NOT REMOVED,

as suggested above, they must remain on the spools or find their way to the cloth. In order to explain the above more clearly, let us assume that we are starting a warper, that has 600 spools in the creel. When the warper is doffed and the spools are pieced again at the spooler we have 600 knots on the 600 spools, not counting the piecings during the construction of each spool. Now let us again assume that when the beam is full these 600 knots are still on the spools, which happens

often when the yarn is on the light side, and, of course, a greater length is on the spools. Again, assuming that a third beam is made, and the knots are all left on the spools, we have then 1,800 knots on the spools. We will again assume that we receive an order for a longer length of cloth, and instead of putting eight raps on the beam, we change the number of raps to nine. It can be seen that the above 1,800 knots would find their way to the cloth, and that is just what happens in mills that increase the number of raps often. Every overseer of spooling will agree that the writer places the number of knots above at a minimum, because the writer has reeled many spools and found as high as twenty knots from the point on the spool when the beam was full to the empty barrel of the spool.

It is safe to say that there are more than three knots left on every spool from the point where

THE BEAM FILLS

and the empty barrel of the spool. The writer in all his mill experience has seen only twelve mills (fine goods mills) where the beam was first doffed, and a certain portion of yarn run on the empty beam to reduce the spooler knots on the spools. The writer is willing to admit that such a practice would not pay in all print cloth mills, because even if the cloth was free from knots, the mills would only receive the same market price per yard for the cloth, and the only advantage gained by a mill employing the warping method suggested above, would be in receiving a larger amount of orders.

But for fine goods mills, the above is very important, and it surely does pay to run a layer or two on the empty beam before the measuring motion is set in those mills where a high quality of yarn is expected. Every mill manager will agree that most orders in all mills are lost through dirty cloth.

Some mill managers have pointed out to the writer the unnecessary expense resulting from throwing away this amount of yarn at each set. But let one question be asked those mill men who conceive such an idea, "What makes you sell hundreds of pounds of good yarn in balls to the rope works, what keeps so many rope works in operation; is it not due to the warper tenders balancing the beams in our cotton mills?" The above must be admitted, because it only takes a visit to most spool rooms to find barrels full of balls made of good yarn. These same mill managers will tell you that

IT IS THE SLIPPAGE

of the measuring roll on the warper that causes a certain amount of slippage more on one warper than another, and that they are about to have all the measuring rolls painted so that they will all draw the yarn the same, and then the beams will empty more evenly at the slasher.

The above idea is wrong, because it should be seen that when the measuring roll on a warper fails to draw the required length of yarn, the beam produced will lack the necessary length. Again, it should be seen that if some of the beams are too long it is not on account of the measuring roll not being painted, as some mill men believe. The amount of yarn on beams is made to vary mostly by dishonest warper tenders who will run a large portion of yarn at each set before lowering the projection in the groove. No. 163.

CLXIV. WARPING WASTE.

Some mill men may point out that there is no gain for a warper tender in running a portion of yarn on the beams at every set, because they would be paid for the amount of yarn if the measuring motion was set at once. The writer knows of mills where the warper tenders know how many more pounds they can add on the beams as the work comes in lighter, and they know enough not to run an extra length when the work is coming in heavy. This is the reason that even overseers of spooling do not understand why it is that

more waste is made from one week to another. Even if the warper beams

ARE NOT BALANCED

by the warper tenders, the weight of yarn will be increased when the work comes in very heavy. But it can be seen from the above that the aim of most warper tenders is to have the beams always as heavy as possible, because that means less creeling, and six pounds too heavy, and in this case the warper tender is careful not to add any extra yarn on the beam. On the other hand, if the beam weighs 368 pounds, the same length of yarn is on the beam, but not the weight, and this means a reduction of wages for the warper tender for the same amount of creeling. So, as stated, they

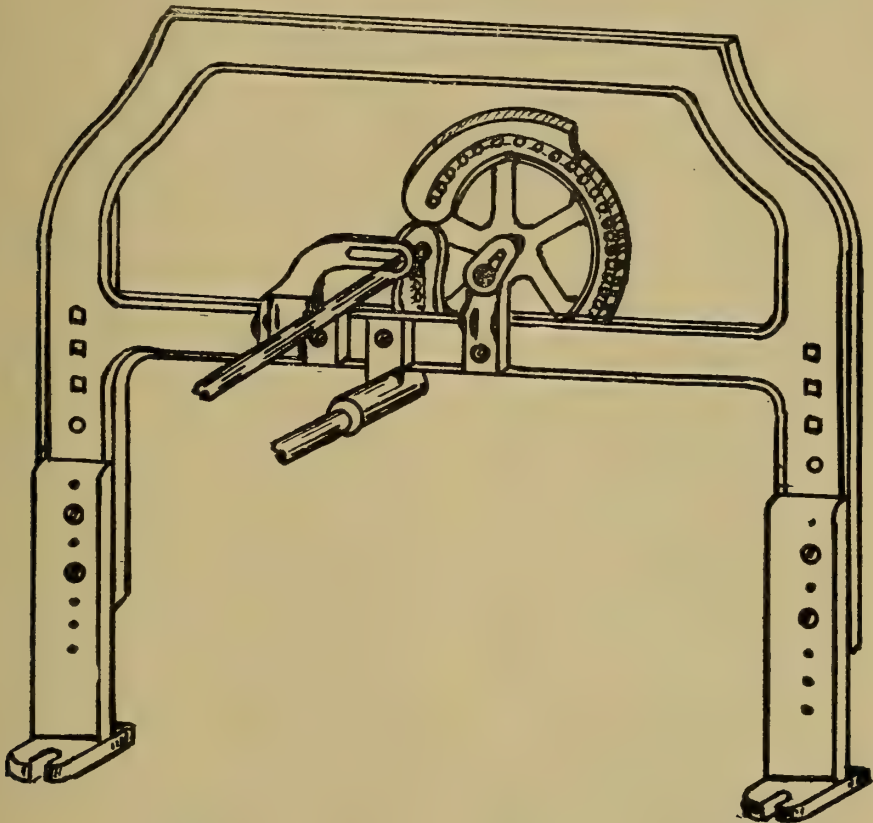


Fig. 52. Mangle Gear and Its Connections On the Spooler.

in this way many warper tenders will tell you that they save a creeling every two weeks by balancing the beams. In order to make the above clear, let us assume that the warper beam weighs 380 pounds and it is supposed to be 28s yarn; by referring to the beam constants the reader will find that the above makes the beam will, as soon as the work comes in light, run a portion of yarn on the beam before setting the measuring motion. The above trouble is seldom located, because the beams are so nicely balanced at all times that the carder and spinner think that it is their good judgment of the stock that makes conditions so good. Very lit-

tle attention is paid to the hundreds of pounds of good yarn that are given away weekly, which is quite

A LARGE ITEM,

because the yarn at this stage of manufacture is very expensive. You will find when visiting most mills that when you find a beam ten pounds from the standard weight, the overseer will tell you that the warper tender ran the beam a little over. All mill men will admit that the above happens in some mills at times, but very seldom, and the writer is willing to admit that in most mills the beams are nicely kept. But it must be admitted that from the above cause you will find the beams in some mills jumping ten pounds from one set to another, which is an impossibility if the measuring motion is properly set in the proper time.

In those mills, you will find the cloth varying from 20 to 40 points, and the beams varying from 360 to 420. The reader is asked to accept the above as true, although it may seem to the reader an impossibility that some mill managers will allow such conditions to exist in their mills.

The writer saw the yarn sized in the mill where the weight of the beams are quoted above, and the yarn sized from 22s to 34s. As stated above, when a beam is found to vary much from other beams in the above poorly managed mills, the overseer instead of admitting that

CONDITIONS ARE BAD.

will tell you that the warper tender allowed the beam to run over, but he does not tell you how often in a week that the beams are allowed to do this. In other mills where you find such conditions, the overseers in charge dare not tell you about them, or are not allowed to change them, as in the ill-managed mill referred to in a previous chapter of these articles.

In the management of warpers, the most attention should be given to the creels. The writer has seen conditions so bad in the warper creels that not a skewer revolved. The chief aim to have good warping is to have the creel so arranged that the different ends will be unwound without snarling, that there will be the least possible strain on the yarn, and that the pull on the yarn will be as straight as possible. The yarn is prevented from snarling in the creel by the good workings of the drop roll. If this roll is not free to follow the yarn as it slackens, the yarn will snarl in the creel and most of these defective places will remain in the same form until woven in the cloth, which gives the cloth the same appearance as knotty yarn. As a rule, snarled yarn is very seldom experienced in mills where the same number of yarn is run continually. Snarled yarn is generally experienced where a radical change is made in the number of the yarn or when the size of the spools is changed.

The drop roll is supported by the yarn alone, and is properly balanced for the number of yarn or spools when set up. When a

VERY LIGHT YARN

is used or when the spools are made smaller if the weight is not somewhat relieved, the roll will drop too fast and when brought to rest, the spools will continue to revolve, thus causing considerable length of yarn to be unwound, and the result is snarled yarn. The above is the same as when the drop roll is not free to drop and follow the yarn. Snarled yarn, if not taken care of in some manner, will break when the warper is again started, if the yarn lacks the necessary number of turns to the inch, and most snarled places will follow the yarn when the latter contains an extra amount of twist. Again, it can be seen that yarn becomes defective in the warper by neglecting its operation. On some warpers instead of a drop roll, the slack yarn is taken care of by what is called a rise roll The rise roll is supported and made to rise by means of a rack, gear, and weights.

The operation is as follows: The weights hanging on the chain

are wound around a small barrel or pulley, which gives this barrel a tendency to revolve in the same direction as the pull on the chain, giving the rise roll a tendency to rise at all times, as it would do if it was not for the tension on the yarn. When the slasher is stopped the weights will cause the rise roll to follow the yarn, and when the warper is started again, the tension should be sufficient to raise the weight or weights.

The

LAST METHOD IS PREFERRED,

because the weight on the roll can be quickly regulated by either putting more weights on the chain or taking them off, while in the first method, some means must be resorted to, to lighten the weight of the roll, or the roll itself must be changed to either decrease or increase the tension on the yarn. The yarn is supported on each side of the drop or rise roll and it can be seen that when the roll either rises or drops twelve inches, twenty-four inches of slack yarn can be taken care of. From the above, it should be seen that the yarn is made to occupy a vertical position when the roll is either low or high on each side of the drop or rise roll. Now if the reader is a mill man, he should here picture in his mind the amount of strain that must be on the yarn to either lower or raise this roll if the roll is too heavy or if too many weights are on the chain. It must be admitted that there are many mills at this writing that can be found where the majority of breakage of ends can be laid to either a heavy roll or too much weight on the chain, or the metal or glass steps not being properly inserted or missing in the creels. No. 164.

CLXV. CARE OF MACHINES.

When the warping is very bad in most mills, the blame is always laid to either poor stock or the yarn not having the necessary turns to the inch. The overseer of warping will tell you that he knows that the trouble is not in the warpers, because they ran very good the week before, and for this reason

NO MATTER HOW BAD

the warpers are running the tension on the yarn is never considered or the creels ever examined.

There is one chief fault that can be found with most overseers in cotton mills, and that is, that instead of making sure first that the machines under their care are in proper order, they will at once find fault with the work received from the preceding processes. My advice to any person having charge of machinery, is to study the object and principle of the machines of which they have charge when there is trouble before trying to blame the other fellow. Try and see things clearly. For instance, when much breakage is found on the warpers if the overseer in charge will stop and study how the different parts of a warper can get out of order or wear to such an extent as to cause the breakage, instead of finding fault with the construction of the yarn, the trouble in most cases will be more quickly remedied, with the result that he will have more comfort. The idea that because the work ran good last week is an indication that the warpers are in good condition is wrong, both in practice and theory. Warpers in very poor condition will run fairly well when good stock is in process, and the

DEFECTS WILL ONLY SHOW

when the stock is poor. The writer while writing on the above subject for a local newspaper in the city in which he lives, was invited to one of the local mills by a superintendent of a mill where the warping was very bad. The writer was told by the superintendent that he had already changed the carder, spinner, and spooling overseers, and that the new men made no difference. The AMERICAN WOOL AND COTTON REPORTER has recently pointed out in a controversy with a superintendent of one

of the largest plants in the country, that changing the men in charge of worn out machinery, or machinery not having the different parts properly adjusted, will not remedy difficulties, if the overseers in charge are not allowed to change conditions, or no supplies given to remedy the latter. The writer instead of examining the yarn, examined the creels, and found the skewers of most spools to be worn to such an extent that the majority of the spools rubbed on the strips that support the steps for the skewer. In other tiers, the steps were found to have fallen from the frame work of the creel, and instead of the skewer revolving as it should have done, the spool revolved on the skewer, thus creating a great amount of unnecessary strain on the yarn besides wearing the spools, which causes them to vibrate on the spooler spindles. If the thread keeps breaking upon the warps, it will possibly stop the machine 100 times before the beam is full. If there are twenty of those kinds of threads in the creel, it will

MULTIPLY THE TROUBLE

in proportion and this lessens the production of the warper, besides making imperfect cloth. The writer examined the creels first, simply because he knew that the chief aim in good warping is to have the creel so arranged and all parts so adjusted that the different ends will be unwound with the least possible strain. Even if I knew that the yarn in process was not properly constructed, I would examine the creels and other parts of the warper, and then when all parts are properly adjusted, and with proper tension on the yarn, the construction of the latter should be given attention. The spools that break back the most should be removed from the creel by the warper tenders, and given to the overseer, who should reel the yarn, size it, and then place it on the breaking machine in order to find its strength. When the writer found the creels in the condition stated above, he advised the superintendent, to have all the creels taken apart in tiers, then lay all the tiers on the floor and a straight edge placed at the top of the tiers and also at the bottom, and if they are found to be uneven when the steps are in line with the straight edge, they should be planed or sawed even. Then metal or glass steps should be inserted in the strips that support the spools, and by this method the least possible resistance to the turning of the spools is obtained. When the creel is set up again, it should be made to occupy a

PERFECTLY VERTICAL POSITION

by the use of a spirit level. By this method if the tiers and steps were perfectly lined to the straight edge, when the creel is made to occupy a perfectly vertical position, all the skewers will occupy a perfectly perpendicular position, and the spools will run between the strips, and not rub on the latter, as found in almost all cotton mills; besides the skewers will revolve in the steps instead of the spools revolving on the skewers, thus saving the spools and preventing vibration on the spooler spindles, and thus removing much strain from the yarn. After a warper creel has been properly adjusted, the skewers should be examined and if found to be slightly worn, they should be thrown into the fire room. Skewers are very cheap, and when they are slightly worn, they cause the spool to move laterally, which causes the spool to rub on the tier strip, thus increasing the strain on the yarn. A spool will run in the above position for a time until the skewer is worn badly and then it will for a time turn at intervals, and more strain is on the yarn. Eventually, the skewer wears to such an extent, that it is at a standstill, and the spool must revolve on it, and there is of course, still more strain on the yarn.

Most readers after reviewing an article will generally tell you that

THEY ARE TIRED

of reading such stuff in the papers. But let me ask the reader why it is that the American Wool and Cotton

REPORTER is continually pointing out defects that exist in most cotton mills, and that are very costly in most cases, and nothing is done after reading such articles even after the proper remedy has been given? If the reader is a mill manager, let him examine the defects that have already been pointed out by the AMERICAN WOOL AND COTTON REPORTER, and he will find them to exist in most all mills. Let me ask again of the mill managers how long ago it is since they leveled the warper creels, or since they had all the skewers examined and the worn out ones taken out of the creels? I dare say that very few mill men could answer the above question to their credit. The most trouble found at this writing in one of the largest plants in Fall River, Mass., is the large amount of breakage of ends in the warper. We never hear of warpers being leveled, or readjusted, still all mill men must admit that there is more wear on the warper skewers than on any other piece of mechanism. This, of course, is due to the weight of the spool when full, which is of considerable weight, (especially in very coarse mills), and besides, the skewers are seldom if ever oiled. Again, owing to the warper creel occupying such a large amount of floor space, the least disturbance of its foundation disturbs the position of the tiers and consequently of the spools. You will find some mills which will not even buy skewers, and many overseers will cut up the sticks used in the springs of the warp drawing machine for skewers. No. 165.

CLXVI. WARPER TROUBLES.

When a large amount of breakage of ends is giving trouble at the warpers and the creels are found to be in good condition, the tension or strain on the yarn should next receive attention. The amount of tension that should be on the yarn can best be gauged by watching the drop or rise roll when the warper stops. If there are too many weights on the chain, the rise roll will rise quickly. When the warper is stopped for any cause, the momentum of the spools causes considerable yarn to be unwound, and this slack in the yarn allows the warper to be started ahead of the spools, with the result that many ends will break, owing to the sudden pull on the yarn necessary to again start the spools. If the drop roll is too heavy, we have the same effect. Many overseers will no doubt take little notice of the above, and at the same time, perhaps their warper tenders are finding fault with the amount of breakage on the warpers. For the benefit of the overseer of warping who conceives the idea that the tension on warpers is always right, let us ask how it is that under the best of conditions, if you stand at the end of a line of warpers, it is seldom you will find them all in operation, even when none are doffing? No mill man can deny the above.

If the warper

WILL STOP OFTEN

when the yarn is properly constructed, what can be expected when the yarn comes in poor? Let us ask again why it is that an attachment known as a cone drive is provided on some warpers by means of which the beam may be driven at a slower speed as the spools become nearly empty, as some overseers of warping seem to believe, if the tension is right at all times?

When a spool is filled with yarn it is larger in diameter when the beam is smaller in diameter, and although the spools are heaveir when filled, the necessary pull to unwind the yarn is not as great as when the spool is nearly empty, owing to the reduced leverage. On the other hand, when the spool is smallest, the diameter of the beam is largest, and here we have two extremes, namely, the extra pull on the yarn caused by the diameter of the spool being small, and the extra pull on the yarn by the largest diameter of the beam driving the smallest diameter of the spool, thus causing the spool when nearly empty to make a much greater number of revolutions per minute.

In order to illustrate the difference in the speed of the spool (not using the cone drive) when the beam winds on the first layer of yarn, and when it winds on the last layer, and at the same time to show how important it is to watch the tension on the warpers, the following example is given:

Let us assume that when the beam is empty, or winding on the first layer of yarn its diameter is 12 inches, and when full, 24 inches, and the spool when full is three inches in diameter, and when nearly empty one and one-half inches. We have when the spools are full and the

BEAM WINDING

on the first layer of ends: 12x12 divided by 3 equals 48 revolutions of spools. When the beam is nearly full and the spools nearly empty we have: 12x24 divided by 1.5 equals 192 revolutions of spools. All practical mill men will admit that the above dimensions are not exaggerated, as it is well known that the actual difference is greater. From the above it should be seen that when warpers are not equipped with the cone drive attachment the tension should be watched at all times, because it is to overcome the above defect that the cone drive has been introduced. Of course it must be understood that no matter how much attention is given to the tension it cannot be regulated so as to give the same results as when using the cone drive. The amount of breakage of ends can be reduced to a large degree by having the drop or rise roll so adjusted that when the warper is stopped the roll will be lowered or raised gradually so as to bring the spools to a stop without unwinding an unnecessary amount of yarn.

The necessary tension will then be obtained when the warper is stopped,

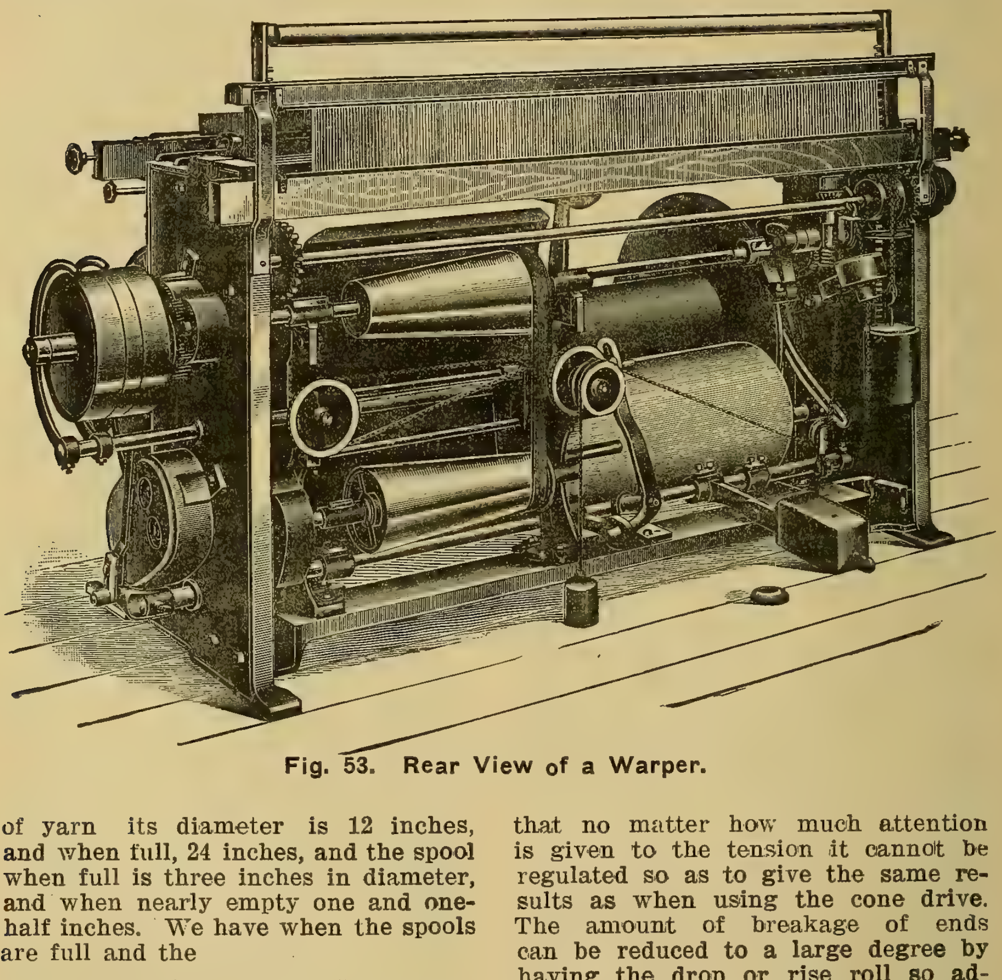


Fig. 53. Rear View of a Warper.

so that the spools will start at the same time as the beam. When warpers are run under such conditions, the best results are obtained, and a larger production with a better quality of cloth is the result. But it must be said, with regret, that the above conditions are seldom found in the warping department of most mills, and if the reader is a mill manager and a bit skeptical about what has been said, let him stand at the end of a line of warpers and see how often they are all running together. When a warper stops, let him examine the amount of slack that is generally found on the yarn, and it will be seen that in most cases the conditions are as stated above. How often do we find the warper tender coming to the overseer and telling him that conditions are so bad that she is unable to

START THE WARPER,

owing to so many ends breaking every time an attempt is made? All practical men know that the above incident happens often, and what is done about it? The warper tenders are frequently told that the work is coming in a little light, or the stock is very poor, and she is asked to struggle along under such conditions until the work is again heavy or until the poor stock runs out. No attempt is made to remedy conditions. The overseer may not even examine the work or the warpers, simply because he has a fixed idea that the trouble is in the preceding processes or in the stock. There are overseers who will, upon receiving complaints from warper tenders, find some means of relieving the tension, even if the cause is due to defects in the preceding processes, or in the stock. By so doing the conditions are improved at once, and the warper tender takes off a larger and better production with less labor. The above is the very reason why some mills have an abundance of warper tenders seeking work, while other mills have warpers stopped for help, the price per pound and class of work being the same. The ends from the spools are threaded through a drop wire, which is either held upright or in some cases entirely suspended by the thread. In case an end or more breaks, the drop wire that it supports falls, and, by suitable mechanism, the machine is stopped. There are two methods used to stop the machine when any ends break. One is mechanical and stops the machine by means of the drop wires coming in contact with an oscillating finger that knocks off the shipper and shifts the belt to the loose pulley. The other also uses drop wires, but the stop motion is operated by electricity.

No. 166.

CLXVII. MEASURING ROLLS.

After passing through the drop wires of the stop-motion, the yarn next passes through the expansion comb, which is simply to uniformly distribute the sheet of yarn, and then over the measuring roll. This roll is sometimes the chief cause of an unequal length of yarn.

A slight difference in the diameter of the measuring roll will make a vast difference in the total length of the yarn, owing, in most cases, to the fact that the measuring roll revolves four times for each yard. By referring to the constant table for beams, it will be found that eight raps of 3,000 yards will make a total of 24,000 yards. So it should be seen that a very slight variation of only one two-hundredth of an inch will make a great deal of difference in the total length of the yarn. However, it must be admitted that the above defect is seldom found to exist, the writer having only found two mills where there was a difference amounting to anything.

If the reader is a mill superintendent it might pay him to caliper the measuring rolls on his warpers if the amount of waste made between the warpers and slashers is large.

The overseer of warping should see that the grooves cut on the barrel are always in good condition. Again, it should be seen that when

CHANGING THE TENSION

on the yarn the total length of it

will be affected. When the measuring rolls are found to vary slightly in diameter, they should be made uniform by adding one or more coats of paint to the rolls having the smaller diameter.

The chief point to watch on a warper in order to reduce the friction is to see that the measuring rolls run free at all times, because lack of oil, end play of the roll, or if the roll is slightly sprung, the total length of the yarn will be affected. The measuring motion on all warpers can be reduced so that from 1,000 to 3,500 yards can be run on a beam.

Some mills run eight raps of 3,000 yards on a beam, while others run seven raps of 3,500 yards, others having different lengths, depending mostly on the length of the cuts, and also the size of the spools. Many rules are given to find the actual production of a warper. One found in our textile schools is to first find the figured production and then deduct twenty-five to thirty-five per cent from the production figured on the basis that the warpers are run constantly. They tell us that such an allowance must be made, as warpers are usually stopped from 1.25 to 1.50 hours for creeling at every set of spools run off.

As with the spoolers, it must be admitted that the production on a warper cannot be correctly figured, because all figured rules must wind up with estimates. The only way to find the weight of yarn upon any beam is to first weigh the beam and mark the weight in the beam head with chalk, and if the beams are not taken from one mill to another, this weight should be left on them, but if the

BEAMS ARE TRANSFERRED,

and as in most cases, left exposed to all kinds of weather, the empty beam should be reweighted, and the new weight marked on the beam head. When the full beam is weighed, the actual weight of the empty beam is deducted from that of the full beam, and, as stated elsewhere, to find the actual weight of the yarn, the waste made between the warpers and slashers should be deducted from the production found on the slate, which can be found by the rule previously given. When beams are exposed, especially in rainy weather, the increase in weight is surprising, and the above has often been the cause of making yarn of a proper size lighter, which causes so much trouble in any mill, especially if the stock is poor. It is useless to figure the production of any warper by the length of the yarn delivered in a minute. Besides, the above estimate will vary in different mills, owing to the quality of the yarn and the number of warpers being run by each tender. Again, you will find some warper tenders who can doff a set of spools in only one hour, sometimes less, while it will take other tenders in some cases over two hours. Why is it that most warper tenders do not use knot tiers? Some mill managers will tell you that they are useless, because all the knots are wound on the empty beam, and as this part of the yarn goes into waste, the construction or quality of the knots are not considered. Although the above is true, let us ask the mill men how many piecings a warper tender makes from the commencement to the ending of the beam.

It must be admitted, as on the spooler, that warper tenders, as well as spooler tenders, will make defective knots, and for this reason they, too, should use the knotter. It is admitted by most manufacturers that the knotter has not only increased their production of spooling with a better quality of yarn, but it has also increased the production of weaving, besides improving the quality of the cloth. That the knotter has accomplished the above no one can deny; then why not use this wonderful little machine at the warpers and again improve conditions? No. 167.

CLXVIII. BEAMS.

When warps are sold by the pound, which is the usual method, if the beams are too light, the purchaser is paying more than the contract calls for, and for this reason orders are often cancelled. On the other hand,

if the beams are on the heavy side, the mill is losing pounds of yarn that are very costly at this stage of manufacture. The warpers are the most neglected machines in a cotton mill, and their neglect does affect the yarn. If their parts are not properly adjusted, it is expensive, because even if the beams are not sold, they are on the heavy side and the filling must be made correspondingly light, as before stated. The beam on which the yarn is wound consists usually of a barrel made of wood, while the heads are made of cast iron. Recently, there has been placed on the market a beam of all wood which has proved a complete failure. The metal heads are best, owing to the enormous weight of yarn that is usually placed on the beam, which proves too much for the wooden heads. A beam head should be tightened when taken out at the slasher, because it is often found that the head on a beam works loose while being filled at the warper, allowing a portion of yarn to get between the head and body of beams, causing what is termed hitch backs at the slasher.

As stated, warping is divided into several different classes according to the manner in which the yarn is treated, and for the benefit of those who have worked in print cloth mills only, the difference will be explained. Too often we find good men in print cloth mills offered good positions in fine goods mills who refuse them, simply because they are told that the yarn is treated in so many different ways in different fine goods mills, that the idea that they will not make good frightens them. What we have said about warpers applies to all kinds; that is, about the creel, tension, etc. The reason why the yarn is treated in several ways is simply because the warp yarn is not used for the same class of finished goods.

This is why a different system of making warp is often used, which is known as chain warping. Again, where warps are required with only a few ends, or for any special purposes, a ball warper is used, but it should be understood that it is practically the same as a beam warping, except that it has

A LEASING DEVICE

and winds the yarn on wooden or paper cylinders instead of beams, This is readily understood, and any man who is successful on warpers in a print cloth mill, will do well in a fine goods mill. A large number of ends collected together form a chain, and like yarn, it may be either single or ply.

The ends of which the chain consist must, of course, be of the same length, but the chains may be made of different lengths. This method is favored by mills producing warps for sale, as it offers, without damage, transportation facilities that are not possible in the beam-warping system. Another reason is, that it is far more convenient and less expensive when transported, and also the most convenient form in which to bleach, dye, and otherwise treat the yarn. Some mills instead of using the balling device, put up the chain in bags, or they link the chains, but these methors do not give the same transportation facilities as when put up in the form of a ball, and for this reason it is the most common method of putting up chains. When, after warping, the chain is linked, it is arranged to resemble the links of any ordinary chain. When balled, the chain is coiled into a round or cylindrical form, by means of a guide fork, return wheel and trumpet, from which it is wound on a wooden core. The word chain is misunderstood by some people, they conceive the idea that the term applies only to that form of chain that is linked and not balled This is erroneous, as the term may be applied to either form. Again, it should be understood, that although the chains are generally made

OF WARP YARN,

filling yarn is sometimes put up in chains also, and for this reason the term is not sufficiently comprehensive. Chains like beams are made in va-

rious lengths, according to the purpose for which they are intended.

For this reason, when a man changes from a print cloth to a fine goods mill, his first requisite is to obtain a knowledge of the uses of chains and of later processes necessary to convert them into the most suitable form for use. This is necessary in order to have a knowledge of the reasons for making chains in different ways, which increases the possibility of constructing suitable chains intelligently. The man from the print cloth mill should understand that the chain is the same as the warp, and the chief particulars required are the counts of the yarn, the total length of the chain and the number of ends in the chain. The calculations are the same as those for the warp. No. 168.

CLXIX. MAKING CHAINS.

Chains like warps are marked to indicate the length, and the only difference is that the warps are marked in the slasher by a coloring matter, which makes a slight impression at the end of each cut, while with chains the operator ties a loose band around or through the chain which serves as

A CUT MARK

The reason for this is that owing to the chain warp being dyed, bleached, etc., it would not be advisable to mark the cuts with colors. The loose bands that are used for cut marks, pass through the bleaching and other processes, and are not removed until they reach the beaming process, and a fresh mark is made either by coloring or otherwise to indicate the cut mark for the weaver. Short chain warps do not pass through the slasher, but instead, are dressed or beamed to a loom beam after having been put through the process for which they were intended.

Any intelligent person having a good knowledge of warping in a print cloth mill, should in a short time become proficient in this system. Long chains are not marked, because they are afterwards beamed to a section beam, and then run through a slasher, and the cuts are marked automatically. A long chain of filling yarn is not marked, because the chain is afterward quilled to shuttle bobbins, and for this reason it should be seen that marks of any kind would be undesirable. One point that must be considered when figuring the cuts or leases, is the loss of yarn, or in other words, the unevenness found in the length of yarn in most print cloth mills. The yarn in

A FINE GOODS MILL,

is worth in most cases twice as much as that made in print cloth mills, and a slight variation in the length of the chains would change what might be a profit into a loss. Too little attention is given to the measuring of rolls in most print cloth mills, and this carelessness would never do in a fine goods mill.

For this reason a good point is to constantly watch the tension, diameter, and conditions of the measuring rolls. It has been pointed out that the variation of tension will affect the length of the yarn produced at the warper, and for this reason when changing from one style of yarn to another, the tension should be adjusted to suit the weight of the spools, and also of the yarn. When the rolls are painted, they should all be made to have the same exact diameter, and should be examined often to see that they run perfectly true.

As a rule, the measuring roll on a warper is $2\frac{7}{8}$ inches in diameter or nine inches in circumference, with gearing arranged so that 3,000 yards of yarn pass the measuring roll when the barrel makes one complete revolution.

On the end of the measuring roll shaft is a single threaded worm driving a worm gear of 60 teeth. On the other end of the shaft carrying the 60-worm gear is a spur gear of 20 teeth, which, by means of

A CARRIER GEAR,

drives a gear of 100 teeth that drives a shaft with a single worm which drives a gear of 40 teeth on the barrel. Assuming the measuring roll to be 9

inches in circumference, as it should be at all times with the above gearing, we have, 1x60x100x40 divided by 1x20 x1 equals 12,000x9 divided by 36 equals 3,000 yards.

As a rule, the barrel has 10 spiral grooves in which the projection rests, and from the above calculations, it can be seen that with ten complete turns of the barrel we have 10x3,000 yards equals 30,000 yards, which would be measured if only one-half the grooves, 5x3,000 yards equals 15,000 yards, would pass the measuring roll. Short chains as a rule are only of a limited length, sufficient to fill one loom beam, which is generally less than 1,000 yards, and sometimes slightly greater than this, while the long chain system is used for making chains of much greater length as stated, sometimes as long as 12,000 yards or even more. The writer gives the following rule that will be found beneficial to overseers in charge of the warping department. With such a rule, you can tell by the diameter of the full beam whether the yarn is coming in heavy or light, or if the warper tenders are running on extra lengths of yarn, or if the paint is wearing off the rolls. It takes about 60 cubic inches to hold a pound of yarn. Rule for finding the number of pounds of yarn on a beam: Multiply the sum of the diameters of the barrel and full beam by the difference of their diameters, then multiply by .7854, and then multiply by the length between the beam heads, giving the cubic inches of

YARN ON THE BEAM

when full. Example: If circumference of barrel is 9 inches, diameter of full beam 24 inches, and 54¼ inches between the heads we have 9 plus 24x 15x.7854x54¼ equals 21090.935 divided by 60 equals 351 pounds of yarn on the beam. When a beam is full and ridges exist, this indicates a wrong division of the ends in the comb, and should be attended to at once, because if the ridges are of a considerable size it will cause the yarn to snap at the slasher when the end is on the highest part of the ridge. No. 169.

CLXX. BALL WARPING.

When the beam is soft on the sides, this indicates that the comb has not been adjusted to suit the width of the beam. As stated, a balling warper is the ordinary section-beam warper used in the regular cotton-warp preparation system for making section beams and so constructed that it can be used in both systems. When a warper is intended to only make balls, a balling attachment is placed in front of it, which consists of a guide fork, pulley, trumpet, and wooden core. On a balling warper the yarn instead of winding down on a beam, passes from the front roll to a guide fork that guides the yarn on what is known as a return pulley situated at quite a distance from the front of the warper. The yarn passes over the return pulley and through a trumpet which guides the yarn on the wooden core laterally back and forth, forming the ball. Before continuing any farther on ball warping it is necessary for those who have not worked in fine goods mills to understand

SOMETHING ABOUT LEASES.

By the explanations already given about warpers, it is understood that the ends pass through the different parts of the warper onto the beam, and at the same time, maintain their position with relation to one another until they arrive at the loom, where they can be woven off without entanglement. It is much different with chain warpers, which are formed by collecting a large number of ends together, making what may be termed a loose rope tied at intervals throughout its length.

When a chain is very short, leases are always taken at each end of the complete chain, the distance between intervals depending on the length of the chain. For instance, if a chain is made 10,000 yards long, a lease should be taken at every 500 yards as a precautionary measure in case that an accident may happen at any time during its passage through the converting or beaming process, with the result that

the ends will become entangled and broken to such an extent that the warp must be cut where such trouble occurs and a fresh start made at the next lease.

The above is just what happens when long chains are tied at every 1,000 yards, and thus by saving only a few minutes labor, many pounds of costly yarn are spoiled, which amounts to quite an item at this stage of manufacture, especially in a fine goods mill. Although the knowledge of different leases is of

NO GREAT IMPORTANCE

and well understood by most all persons working in a fine goods mill, their differences are explained here, because the writer is aware that it will be interesting, and instructive as well, to those who never had the pleasure of visiting a fine goods mill or to those who have spent their mill life in a print cloth mill. It has been the writer's aim from the beginning of these articles, to give the readers of the AMERICAN WOOL AND COTTON REPORTER as many original practical points about a cotton mill as possible. But the systems and operations of a fine goods mill differ from those of a print cloth mill to such an extent that the vast difference is only realized when the systems of both mills are examined from top to bottom. This vast difference has been the cause of good men refusing good positions, simply because they did not expect to make good, and although such reading may be a little tiring to the people of a fine goods mill, it must be admitted that such information is necessary and valuable to any person contemplating a change, and the writer's aim is to encourage such people so they will take a chance, and by so doing perhaps better themselves.

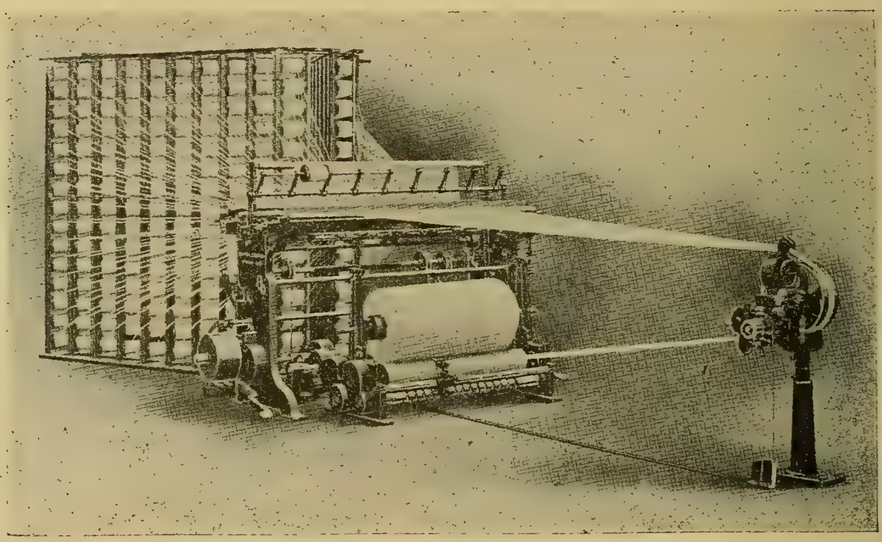


Fig. 55. Ball Warper.

In order to explain chain warping without confusing the reader, the kinds of leases and their object must be explained. The difference between

A THREAD LEASE,

pin lease, open lease, bunch-knot lease, bout lease, lease bands, and water bands must be understood by all persons having charge of any department in any fine goods mill. Thread leases are used at the chain warping so that the ends will remain in the same position with relation to

one another that they occupy in the loom. A thread lease is taken by raising every alternate end which forms an opening through the warp, one-half of the warp forming the top of the shed and the other half the bottom.

The above can be best understood by print cloth people, by considering the object of the lease rods on a plain loom, where it is customary to pass one series of alternate ends over, and the other series under the lease rods behind the harnesses of the loom. The object of this on a plain loom is to effectually separate the ends of yarn in readiness for passing through the harnesses and reed, even if any two or more ends are held together through improper sizing, etc. The thread lease is taken instead at the chain warper when the shed is opened, when what is termed a lease band is passed through this opening and the warp is then closed and opened again by reversing the position of the ends and forming another shed. Another band is then passed through the second shed and the ends of the two lease bands are tied. The reason for this should be seen, because the lease bands when tied provide a means of maintaining the lease throughout the succeeding processes, and at the same time,

THE WARP ENDS

are separated into two equal portions. A band lease is a cord or band that is used for taking and maintaining the lease which consists of a number of ends of yarn, usually from ten to twenty-ply. These bands are made usually from the tail ends of the beams at the slasher, cut up in different lengths to suit the number of ends in the chain, and are as a rule made of a different number of ends. This is done so that in case of dispute the warp can be identified by the number of plys in the lease, and in this way, the warps made from a certain mill, or a certain beamer that is in any way defective, can easily be traced back. A water band is used simply to prevent entanglement in boiling the warp preparatory to the converting process. They are made of a larger number of ends than the lease bands, and are made into loops when tied around all the ends of the warp. A thread lease differs from a pin lease, because with a pin lease the warp instead of being separated at every alternate end is separated into alternate groups of any desired small number of ends that must be lifted by a harness or harnesses. For instance, the ends in the warp are separated so as to form a shed with 6 ends down, the next 6 ends up, the third group of 6 ends down, and the fourth group of 6 ends up, and so on throughout the width of the warp, when a lease band is then passed through the shed. Then by

REVERSING THE POSITION

of the ends another shed is formed and another band is passed through this shed and the ends of the two bands tied. The chief use of pin lease is to form a coarse division of the ends to make their separation easier at the beaming process, because it takes much less time to separate the warp in groups either small or large than to separate each individual end. A pin lease is used to advantage in the dyeing and bleaching processes, as it makes it easier to split the warp into sections to make up the assortment of threads forming different patterns in the warp. No. 170.

CLXXI. THE OPEN LEASE.

An open lease is used where two consecutive thread leases are taken when in a reverse position to one another, which leaves the warp open between them. When the ends are divided by hand into groups equivalent in size to several of the groups formed by a pin lease, it is called a bout lease. Sometimes chains are ordered split, and must be divided into two equal parts, which is termed a large bout, and the two parts of the chain are kept separate by lease bands. When a warp is cut off, what is known as

bunch-knot leases are formed at the ends of each warp, by taking a hand lease, dividing the warp into 4 or 6 approximately equal sections together. From what has been said, it can be seen that the only difference between

THE WARPING DEPARTMENT

in a coarse and fine mill is that in the coarse mill the ends forming the beam pass from the warper in a level, even sheet, maintaining their position with relation to one another until they arrive at the loom, whence they can be woven off without entanglement, while in the fine goods mill, or where colored yarns are produced, chain warps are formed by collecting the ends into a loose rope or yarn, grouped at intervals, which is accomplished by inserting leases as was explained. Not forgetting that we are studying ball warping, it should now be understood that the thread lease is the kind usually taken on the ball warper, for which it is customary to use a reed.

A reed is used to make leasing easy. This reed is so constructed, that alternate ends pass through eyes in the steel wires which form the reed, while the other ends pass between the wires of the reed. When it is necessary to take a lease, the reed is raised and the ends in the eyes of the wire in the reed are also raised, while lowering the latter depresses these ends.

On the other hand, the ends between the dents are not acted upon by the movement of the reed, thus a shed is formed. As stated, the yarn on a balling warper is maintained in an even horizontal sheet until it reaches the front roll. From the front roll it passes to a guide fork that serves to condense the yarn into a chain, and then it passes over a pulley called

THE RETURN WHEEL,

because the yarn must be returned to the balling attachment which is situated where the beam is found in the ordinary warping system. The return pulley is revolved freely by the yarn passing over it, and serves merely as a guide for the chain in its passage to the balling attachment. The return pulley is mounted on a stand fastened to the floor. From the return

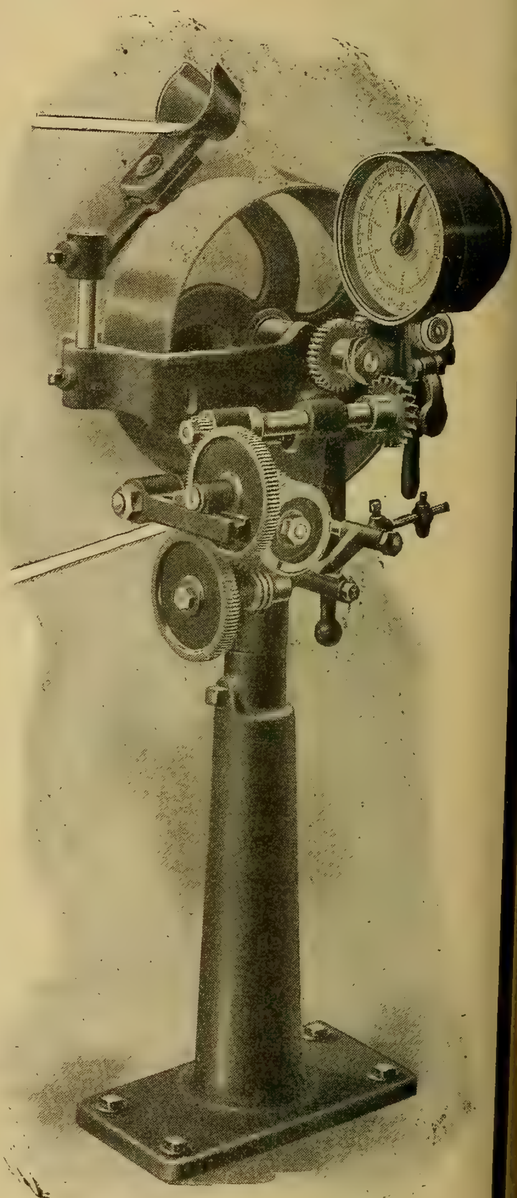


Fig. 56. Enlarged view of Floor Stand For Ball Warper.

pulley the yarn passes through a trumpet which properly lays the chain in

spiral coils on the core. The balling attachment consists of two sampsons secured together by means of bars fastened at each side. The two sampsons are tapered at their upper part and each has a slot that serves as a support and guide for the shaft upon which the wooden core is mounted.

The core or ball is made to revolve by two rolls on which the core and ball rests, which are connected by gearing so as to revolve at the same circumferential speed.

The trumpet through which the chain passes is given a traverse motion in order to produce the cylindrical form of ball desired. When only one ball is formed at a time, the width of the traverse is generally almost equal to the length of the core.

The trumpet is given a traverse motion by means of a heavy steel screw or shaft that has a continuous double thread deeply cut into its surface, and by one thread being right hand and the other left hand, the

TRAVERSE IS OBTAINED

by means of a pin that fits into the two threads, and as the pin is cast with the bracket which supports the trumpet it follows the pin.

As on all other machines having a traverse motion for the laying of the strand, the speed of the screw-shaft can be regulated so as to give a closed or an open spiral wind of the chain on the core. As on the warper previously explained, the tension must be given much attention, so that the tension for winding the yarn will be practically the same throughout the formation of the ball.

This is accomplished by means of a friction pulley, partly around which passes a friction strap that is secured to a stud on one side of the pulley, and at the other end to a weighted lever, 'by which the tension can be regulated. The principle of this device is to counterbalance the decrease in the amount of power required to overcome the friction. The counterbalance is accomplished by a strap which acts upon the small diameter of the scroll, so that when a ball is first started, a greater force is required to turn the friction pulley. As the ball fills it raises a casting, and the effective diameter of the scroll increases so that the leverage of the strap is increased and less force is required to turn the friction pulley. In this way the consumption of power is equalized from the commencing and ending of the formation of the ball. When the tension is less at the start than at the finish of the ball, the ends of the latter will bulge out, and when the tension is less at the finish than at the beginning, a soft ball is formed. No. 171.

CLXXII. WARPING AND RETURN PULLEYS.

To most people employed in the warping department of a fine goods mill, the reason for the use of a return pulley is little understood by them. The writer has even heard overseers of this department remark that this device could be made obsolete. There is no doubt but that a device could be arranged to take the place of the return pulley, but it would be doubtful if it would work as well, because such a device would have to be in the form of a binder, and it is safe to say that its efficiency would not be as great. For the convenience of illustration to give the reader an understanding as to why the return pulley is situated at such a distance from the balling attachment, we will assume for the present, that the return pulley is placed at only 25 inches from the core, and that the maximum width of the core is 50 inches. With such an arrangement, it should be seen that the speed of the spools would vary, because as the distance in the central part of the core to the return pulley is only 25 inches and over 30 inches at each end of the core, it is obvious that the spools would be made to revolve faster as the trumpet approaches each end of the core, and that the speed decreases as the trumpet approaches the central part of the core. It is

needless to say that such an arrangement would result in

VERY BAD SPOOLING

because it is for the above reason that an attachment is provided for on beam warpers so as to equalize the speed of the spools. Again, it should be seen that with such an arrangement the speed of the spools would be changed at every traverse.

The above is given to show that moving the return pulley nearer to the balling attachment is wrong, and is the very reason for poor warping in some fine goods mills. Some overseers will tell you that they get better warping by having the return pulley as close to the balling attachment as possible, and they point out that by reducing the distance from the front roll to the return pulley, the yarn will carry better, and consequently with less breakage. This is erroneous, because the amount of distance that the return pulley is moved, will more than destroy the above advantage by the variation of the speed of the spools that a slight movement of the return pulley will cause, which causes much breakage in the creel.

For the above reason, the return pulley is situated far enough to destroy almost the variation of the spools caused by the angular position of the chain. There is no fixed distance, because the distance depends upon the width of the core or ball to be formed. A good rule to gauge the distance, is to watch the spools when they are nearly empty, as the variation in speed at each traverse will be noticed more at this point. It must be understood that no cone attachment is provided on the warper explained above. It is customary

ON MOST BALL WARPERS

to have an arrangement to register the number of yards of chain passing through the warper by means of a finger, sometimes two fingers, that indicates the number of yards on a dial, which is called a lease clock. When this measuring arrangement is used, an arrangement to stop the warper automatically when the desired length of chain has been warped is also provided for, and by means of a bell, the warper tender is notified. However, you will find in many mills that instead of having these two arrangements which work in combination with one another, the barrel is marked in divisions of one, two and five and the tender has to watch these marks continually at each warper, which is very inconvenient.

The above is one of the chief faults with most mill managers, they look at the initial cost too much. It seems that they do not realize that such arrangements quickly pay for themselves. Imagine a tender running three warpers, and when she is tieing on one warper, she has to leave her work to come and watch the barrel, and although the writer is willing to admit, that most of these warper tenders can gauge the time very closely from experience, still it must be admitted that the warning of a bell enables the tenders to turn off a greater production with less care, besides they are not so liable to run an extra length of yarn which happens often when

LEASE CLOCKS

are not provided. It also happens often that the tender is unable to give the exact amount of short cuts run on a ball. Although cut lengths are generally about 50 yards, they are sometimes made (for samples) very short. The lease is inserted at regular intervals, although the chain may be 12,000 yards long. For this reason it should be seen that when a cut is allowed to be run over that a great amount of yarn is sometimes made useless, and besides by having only the marks on the barrel to judge the distance to the next cut, the amount for the present is unknown.

On the other hand with a lease clock the amount of yarn passing through is indicated to the yard. The change can easily be made, as the clock is driven from the shaft of the measuring roll, by the single worm previously explained. This worm drives a worm-gear of 48 teeth, and on the

same stud there is a spur gear of 16 teeth, driving one known as the cut gear. On the same shaft with the cut gear is another which drives a gear of 64 teeth. On this stud a 16-tooth gear drives a change gear called the lease change gear. By this gear the different lengths between the leases are obtained when

LONG CHAINS

are run. On the same sleeve with the cut gear is a collar in which a notch is cut to allow a curved arm to drop into it when a cut has passed the measuring roll. When this drops into the notch on the collar, it causes a hammer to strike a small gong, which indicates to the warper tender that a cut has passed the measuring roll. The leases are marked in the same manner as on the beam warper, that is, on the same stud with the lease change gear is a barrel carrying coarse spiral threads as on the barrel on the measuring roll found at the beam warper, between which rests also a projection.

This barrel instead of having only one place at the end of the barrel for the projection to drop when the beam is full, has a groove cut lengthwise along its surface, sufficiently wide and deep enough to allow the projection to drop into it. So it can be seen, that like the cut change gear altering the length of the cuts, different sizes of the lease gear give different lengths between the leases. The number of teeth in the change gear is such that the barrel will make one complete revolution, while the number of yards intended between lease bands is passing through the machine, and at the same time, the barrel will have revolved so as to be in the right position for the projection to drop into the groove, which causes a bell to ring. The reader is now asked to stop and think, and consider how some mill managers stand in their own light, by not having such an arrangement.

It can be seen from the above, that the warper tender knows when the gong rings that a cut has been completed, and when the bell rings, that a lease has been completed, while on the other hand, a warper tender is

ASKED TO REMEMBER

all this by unreasonable managers, and if a mistake is made, which, of course, happens often, the tender in most cases is discharged, with the result that new hands are found in such managed warping departments, and the quality of the work is sure to suffer through poor management.

No. 172.

CLXXIII. WARPING CALCULATIONS.

The lengths of cuts and leases are found by the following rules. The first thing to do is to find the constant for the cut change gear which is obtained as are all constants factors, that is, call change gear one. Referring to the gearing already given, and assuming the measuring roll to be 12 inches in circumference we have 48x1x12 divided by 1x16x36 (inches in one yard) equal 1 constant factor. Assuming the cut gear to be 50, the constant being a factor, we have 50 divided by 1 equals 50 yards cut, or 50 yards times 1 equals 50 change gear.

Next find the lease change gear constant by leaving out the change gear and calling it one as in the above example. 48x50x64x1x12 divided by 1x 16x16x16x36 equals 12.5 constant factor.

Assuming the change gear to be 60 teeth, we have 12.5x60 equals 750 yard lease, or a 750-lease divided by 12.5 equals 60 change gear. It can be seen by those that are able to figure that length of yarn on a beam in a print cloth mill, that the calculations are similar, and just as easy, and that there is nothing to fear.

The only difference is that a suitable arrangement of the projections on the collar and barrel are connected with the stop-motion, and in this way, the warper is stopped at the

END OF A CUT

and of a lease and also at the end of a complete chain as on the beam warper when the beam is full. Many mill

men, in order to economize floor space, have the chain carried from the front roll on the warper to the ceiling of the room, and pass it over the return pulley that is fastened to the ceiling, and then bring it down to the trumpet on the balling attachment. This is a very poor arrangement. In the first place, it is very inconvenient to pass the chain over the return pulley, and in the second place, when a very wide ball is being formed and the speed of the spools is greatly affected at each traverse, the return pulley cannot be moved without giving the sheet an angular position, that would bother the operator more or less, besides it is seldom when such a space is available on any ceiling. The variation in speed of the spools on a ball warper bothers most when only one ball is being made, when it usually occupies the width of the core. No definite information can be given for making balls, as balls are sold the same as cloth; that is, the number of ends or the length and weight of a balled chain, is determined by the purchaser. When more than one ball is made at one time, the traverse screw must be changed to one that will suit the width of the balls. Three balls are often made at one time, but to do so a

TRAVERSE-GUIDE SHAFT

with either two or three guides must be used, as the case requires, and the traverse shaft in each case must have the same number of sets of threads, so that each guide will be operated by these separate sets. When a very great number of ends are required, or when the chains must be balled and linked, the machine most commonly used for making such chains is known as the Denn warper. On the Denn warper, besides a larger number of ends being possible, the chain can be made up of any reasonable desired length. The Denn warper is made with creels to hold from 1,000 to 4,000 spools, and although this is claimed by many writers to be an advantage, it is safe to say that it does not pay to have them with more than 2,500 ends. The reason for this is obvious, for, when a warper contains 4,000 spools, every time one end breaks 4,000 spools are stopped.

Although it must be admitted that the first cost is greatly reduced by adopting the largest creels, it will be found a small matter when compared with the total cost of the production that is felt weekly. What has already been said about the creels of the beam warper applies to the Denn warper as well.

The chief difference is in the construction of the creels, which owing to the necessity of providing for such a large number of spools quite a few separate creels are used, the amount depending on the

NUMBER OF ENDS.

They are all similar in construction and in tiers like the beam warper creel, and adjusted at the required distance so as to allow the largest spools to be inserted between the tiers.

In order to reduce the friction immediately in front of the face of the creel from which the yarn is delivered, in case the mechanical stop-motion is used, are a series of vertical iron rods instead of metal or glass rods on the outside strips. In case the electrical stop-motion is used, the iron rods are not used, but the stop-motion wires occupy about the same position as the iron rods. In order to give the warper tender a convenient passageway between the creels to tie in the new spools or to piece up broken ends, the creels are set at such a distance apart that if they are not properly stayed, the majority of the spools will run against the strips, and the result of such a defect has already been explained.

A Denn warper is also generally equipped with an eye board, which serves as a guide to bring the ends into proper position, and at the same time, holds them in the same relative position to one another as the spools in the creels. With such a board, in case of a broken end, it facilitates the

finding of the spool from which the end has been broken. The rows of holes in the eye board are numbered to correspond with the rows in the creels, and in this way the tender can

TELL AT A GLANCE

in what row in the creel the broken end is.

When a linker is applied to a warper for the purpose of making links in the chain, the linker may be single or double. The difference between a single and double linker head is that a single linker makes a link of three thicknesses of the chain, while the double linker makes the chain five thicknesses. It should be understood here that the single link chains are reduced one-third in length, while the double linked chains are reduced one-fifth. For this reason the single linkers are seldom used, besides the superiority of the double linker over the single linker is never questioned. No description of the linker is given, because although simple in its construction and operation, it would require too much space that would be of no benefit to the reader, and the only way to learn how to operate a linker is by practice.

No. 173.

CLXXIV. BALL WARPING.

On a Denn warper, in case it is desired to ball the chain instead of linking it, the yarn is carried downward at an angle under the warper, then through a guide, and around a return wheel to the balling attachment at the front of the warper. The balling attachment on a Denn warper is similar to that used on the ordinary type of balling warper, and is usually situated about midway between the upright standards of the machine; that is, when only one balling attachment is applied. Denn warpers

ARE ALWAYS EQUIPPED

with lease clocks, and automatic stop-motion. This is because, as a rule, the chains must be made of a certain length, and also of a specified number of cuts, so it is of advantage to have the machine stop automatically, because in addition to notifying the warper tender, it stops the warper in the proper place for inserting lease or cut bands. The measuring motion on the Denn warper differs very much from the warpers previously explained, although the principle is the same and figured in the same way.

The chief difference is that there are three cut change gears, and that instead of a notch collar and arm to strike a gong, a pin is used that presses a wire for a part revolution and then releases it suddenly. The number of cuts required between lease bands is obtained by placing a pin in different holes of a disk, instead of a projection running on a barrel. Again, on a Denn warper the alarm is given at the end of each cut by a bell instead of a gong, and the alarm at the end of each lease is given by a gong instead of a bell. From the above, it can be seen that any person not acquainted with both systems would be confused at the start. This has been the chief aim of the writer; that is, to give valuable information, and at the same time prove to the reader that it is all easy if you give a part of your attention to machine calculations. But I regret to say that among

THE COTTON WARPERS

there are few that even read a textile paper, and that is where a great mistake is made, because the writer knows this from experience, as I began to make good since my first clippings of valuable information obtained from the pages of the AMERICAN WOOL AND COTTON REPORTER some twenty years ago. Not forgetting that we are studying the measuring motion on the Denn warpers, the worm instead of being on the end of the measuring roll is on a cross shaft which drives a worm gear of 78 teeth that has on the same shaft a gear of 27 teeth and drives, through a carrier gear, another gear of 78 teeth, which is fastened to the shaft that carries the collar and pin for striking

the bell at the end of each cut. All three gears referred to above are all change gears that must be altered for the lengths between cut marks, between lease bands, and for the entire chain. The circumference of the measuring roll is usually 24 inches. other end of this side shaft has 26 teeth and meshes with the gear of 26 teeth on the cross shaft. In calculating

THE CUT LENGTHS,

first find constant by the above train of gears given.

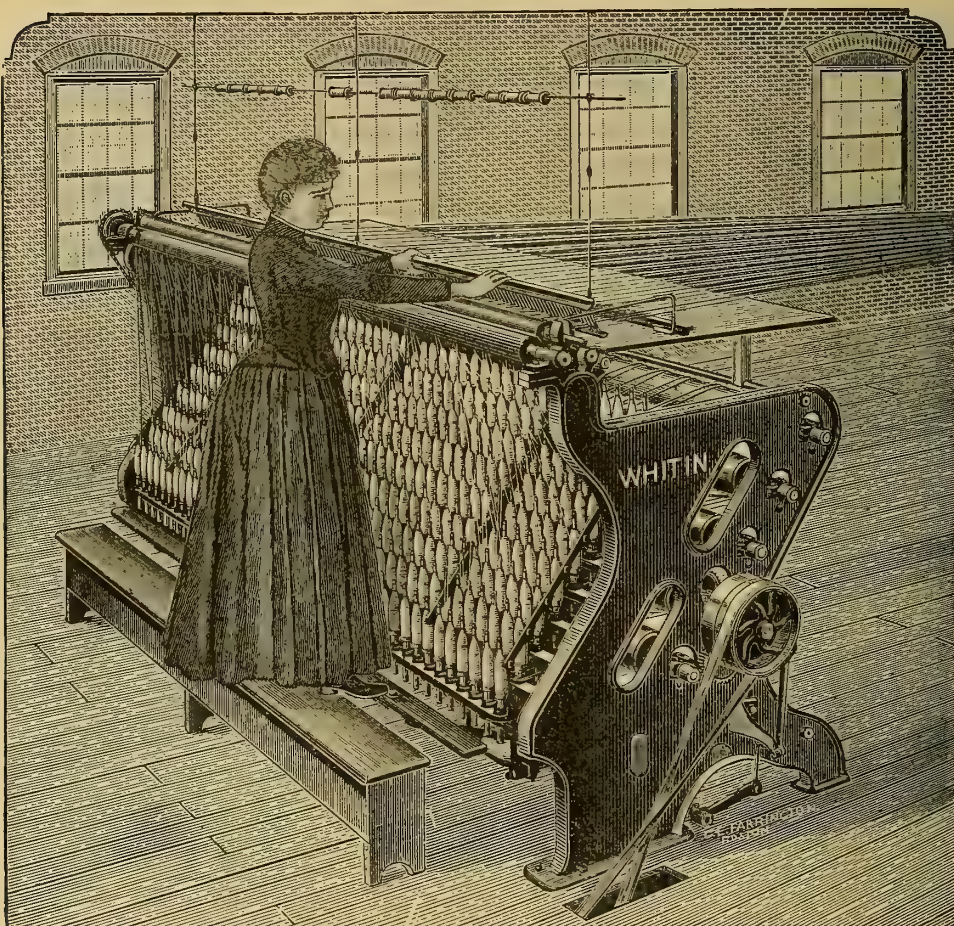


Fig. 57. Quilling Machine.

and carries a bevel gear that drives by means of another bevel gear a side shaft carrying another bevel gear mounted on the same cross shaft on which is the single worm. The bevel gear at the end of the measuring roll has 54 teeth, the bevel gear meshing with it has 18 teeth, the gear at the

Considering one of the 78 teeth gears as a change gear we have: 24x18x26x1x78 divided by 54x26x1x27x36 equals .6419 constant factor. .6419x78 equals 50.068 or 50 yards. The reader's attention is called to the fact, that owing to the number of change gears, two constants must

.e obtained; for instance, if what is called the cut pinion gear is changed instead of either 78 teeth gears, the constant must be a dividend. Using the same gears and leaving out the cut pinion gear we have 24x18x26x78x78 divided by 54x26x1x1x36 equals 1,352 constant dividend; 1,352 divided by 27 equals 50.078 yards or 50 yards per cut. The above calculation should clearly be seen, as one 78 gear is on the same shaft as the collar and pin, so that any change in the train of gears acts correspondingly on the pin that sounds the alarm at the end of each cut.

The disk for marking leases is mounted on a short stud and has rachet teeth on its outer edge, and in its inner part in a circle a series of holes are arranged. Around the hub of the disk is wound a cord that is passed over a pulley, and carries a weight on the other end, which gives the disk a tendency to revolve in the opposite direction to that moved by the pin. At the same time that the cut alarm is sounded, another pin, which is on the same collar with the pin that strikes the cut bell, moves the disk a distance of one tooth.

The disk is prevented from turning by a pawl held in contact with the teeth on the disk by means of a spring and holds the

DISK IN POSITION

after it has been moved one tooth by the pin on the collar. The pawl is operated by a long arm that is mounted on the same stud with the disk, and hangs downward close to the face of the latter, and is operated by a pin in the disk. The disk as a rule contains 31 holes all numbered, and in case there should be 20 cuts between leases, this pin that operates the arm is placed in hole number 20. So from what has been said it will be seen that when the striking pin on the collar has made 20 revolutions it will have moved the disk 20 teeth which brings the pin in the 20th hole in contact with the hanging arm. The pin presses the arm and the arm presses the pawl entirely out of contact with the ratchet teeth on the disk. As soon as the pawl is pressed out of contact with the ratchet teeth, there is nothing to prevent the disk from revolving in the opposite direction to that operated by the pin in consequence of the pull from the weight on the cord. The disk continues its backward movement until another pin on the disk strikes the arm and removes it from the projection on the pawl, which allows the pawl again to come in contact with one of the teeth of the disk, which prevents it from turning any further in this direction. In this way the disk is stopped in the proper position for starting another chain. When the disk makes its backward movement it allows the cord

TO BE UNWOUND

and another pin situated between two ratchet teeth, to come in contact with one end of a lever when the opposite end of this lever strikes a gong. From what has been said it can be seen that there is very little difference between the two systems and that making chains on the Denn warpers is as easy if not easier than on any other type and the chief factors to remember when changing from one system to another is that gong and bell rings opposite in each system. Another thing to remember is that on Denn warpers all changes are made by the two 78-tooth gears and that having 27 teeth two constants are necessary, while in other instances the entire three gears must be changed and neither constant can be used. As on the warpers in a print cloth mill, very little figuring is required, and the only calculation of any importance besides what has already been given is in finding the weight of the chain.

This is found by dividing the product of the total length, in yards, the total number of ends in the chain, and the ply of the yarn by the product of the number of yards in a hank and the counts of the single yarn that constitute the ply yarn. Example: What is the weight of a chain 12,000

yards long that contains 3,000 ends of 2-ply 20s? 12,000x3,000x2 divided by 20x840 equals 4,285.71 pounds, total weight of the chain. No. 174.

CLXXV. WALCOTT WARPERS.

Another type of warpers that differs from the Denn warpers, is known as Walcott warpers. On this type of warpers the sheet of ends is brought downwards from the creel, so that the warping will be as close to the floor as possible. This is done because the sheet must be passed upwards over a guide roll, and by the sheet being warped as short a distance as possible from the floor, it makes it possible to have the height of the guide roll low enough so that by the aid of a low staging it will not be out of the reach of any ordinary person. The chief advantage of the above arrangement is that it affords ready access to the broken ends. The passage of the yarn from the creel is about the same as on the Denn warper, the yarn passes through an eye board also, and over a measuring roll, under a guide roll, and through two lease reeds that are mounted on stands fastened to the frame of the warper. From the reeds, the sheet of ends is conducted over another guide roll to another large roll known as the draft roll.

The object of this roll is to equalize the pull on every end and for this reason it is covered with cloth, and the ends are made to encircle almost its circumference by means of two other rolls placed in a suitable position between the draft roll and the guide roll over which the sheet passes. With such an arrangement, a steady and even pull is on every end, so that all the ends shall, as nearly as possible, be of one length in the completed chain. The guide roll over which the sheet passes from the draft roll has the same surface speed as the draft roll, although very much smaller in diameter.

At this point on leaving this roll, the yarn is changed from an evenly laid sheet, to the form of a loose rope, and carried around a guide pulley to a condenser known as calender rolls. The top roll is made sufficiently heavy to condense the chain and at the same time draw it between the two rolls. The self-weighted roll is driven by frictional contact with the bottom roll, and is raised by a chain attached on each side of it. From the

CONDENSER ROLLS,

the chain is then passed to any receptacle, such as a bag, box, linker or balling attachment. The calculations, the method of inserting leases, and the types of leases are so nearly alike on this type of warpers that what has been said on Denn warpers can be applied here. The Walcott chain warper of 1,200 spools occupies a space of only sixteen by thirty-two feet, and eight and one-half feet high. When a stop motion is added, it occupies a space two feet longer. It is claimed for this warper that one machine will do more and better work than three upright warpers. While a Walcott warper could, of course, be constructed for more ends, the builder of this warper advocates only 1,200 spools, while the writer advocates 1,500. Still, the writer is willing to admit that there is no economy in running over 1,200 ends from one creel, for reasons previously explained. The next process in which the yarn is treated depends on whether it is used for warp or filling, and whether the chain is short or long. Again, it should be understood that the use of leases is to prevent any unnecessary entanglement of the yarn during the converting processes, such as, dyeing, bleaching, or other treatment, and also to decrease the risk of damage in transportation. For a short chain the next process is dressing, or beaming, to the loom beam; for the long chain the next process is dressing, or beaming, then to the section beam, and if intended for filling yarn, the next process is quilling.

From what has been said, it should be seen that it is usually necessary to manipulate in various ways the yarn forming the chain before it is used for the purpose intended. The next process in which the warp yarn is treated is known as beaming. The object of beaming is to rebeam or rewind the colored or bleached chains after they are returned from the dye house. To most manufacturers familiar with the manufacture of colored goods, beaming is the most difficult and unsatisfactory process in all manufacturing, owing to the endless number of broken and snarled chains, slack threads and twisted selvages, which are continually turning up in the beaming room, however careful the dye house is managed.

No. 175.

CLXXVI. CHAIN DYEING.

All manufacturers of colored goods should employ a method by which the excessive damage done to the yarn in the chains in the dye house might be avoided, and thus render the beaming and following processes less difficult. In some colored mills, managers consider only the

INITIAL COST

and for this reason, instead of purchasing machines by which the snarling and breaking of the chains in the dye house can be prevented, they will allow their men to struggle along under unsatisfactory conditions. Methods employed in some dye houses save at least one-half the whole cost of beaming, not considering the gain in the weaving rooms, from the greatly improved preparation and the absence of knots and snarls. There is no doubt but that many mill managers not having such machines will take exceptions to the above statements, but why is it that in some colored mills on the same style of goods, the weavers are able to run more looms than in another?

If it is not in the preceding processes, why not find out where the trouble is, and not allow colored warps to reach the loom full of snarls and bunches? Several years ago the idea was conceived of winding around each chain from end to end a cord of suitable strength to hold the yarn together and prevent snarling and breaking in the dye house, and by mechanical methods unwind the cord from the chain. To-day, such a machine is on the market.

The above device is better known as the winding and unwinding process, and is found in use in the principal mills which use

COLORED WARPS.

By its use at least one-half the whole cost of beaming is saved. The method most commonly used for short-chain warps is known as the overhead process, sometimes called Yorkshire dressing, owing to it being so widely used in Yorkshire County, England. The chain from the balls that are placed on the floor are passed upwards between two rolls, usually of wood, then over a slotted block of wood, when the ends are separated and arranged in the same position as when warped, which is governed by the leases.

As the yarn opens out, it passes to a frame work that consists of two stands that support wooden bars, usually oval and made very smooth so as to prevent damaging or cutting the yarn. This framework is situated at a distance of several feet from the warp to give the yarn ample time to separate.

The object of the bars, is to separate the sheets when more than one chain is run, so that the various ends will occupy the same relative positions as when it was warped. In this way each sheet passes over its respective bar, downwards around a roll to the loom beam. In

THE BEAMING OPERATION,

the distance allowed the yarn to open out is not sufficient for some ends that have become slightly entangled by the dyeing or bleaching processes, so for this reason, the beamer should stand be-

tween the two sections of the machine and constantly pass a brush over the surface of the warp, between the reed and the beam. In this way the brush destroys any entanglement that may exist. A beamer must at all times operate a reed that is supported by the sheet of ends and it should be moved gradually with and against the direction of the yarn so as to open up the sheet effectually without breaking the ends. If a pin contains 6 ends, as was explained, 6 ends are passed through each dent of the reed, and if there are 8 ends to a pin, 8 ends are passed through each dent.

The object of the reed is to open the chain into a level sheet of ends, thus allowing it to move like the reed in the Yorkshire system. The expansion comb regulates the width of the sheet. The object of the tension drum is to give the chain necessary tension so that the yarn can be opened properly and wound on the beam more compactly, and at the same time, take out the snarls, and also remedy the slack threads that may exist in the yarn. The operation in both systems is about the same, and any person who can operate a machine in one sys-

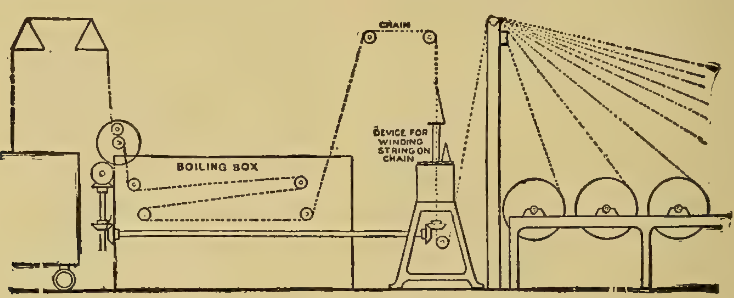


Fig. 58. Winding Process for Chain Warp.

With one beaming machine used for long chains, a ball is placed on the floor between the two sections, namely the drums and the section beam, and one end is passed up over a guide pulley, which is generally supported from the ceiling, then downwards to the lower drum known as the lower tension drum, up between two of the guide rolls situated between the two section drums and free to revolve, around the upper tension drum, down between two other guide rolls to the lower tension drum again, upwards around the upper tension drum, and from here, it passes downward to a return wooden roll supported by two stands fastened to the floor; then it passes back around a pulley situated over the

TWO TENSION DRUMS

to the front through a swinging reed and through an expansion comb to the section beam.

tem can operate the other in an hour or two of practice. From what has been said, the reader should notice the chief difference in the two systems, that is, the overhead process of beaming is a dry dressing, while the Entwistle type of beaming is the same as in the print cloth mills, only, of course, the yarn is colored. The section beams from the beaming machine are placed in a slasher and there sized and placed on a loom beam, as in a print cloth mill, and afterwards drawn through harnesses and reed when the warp is then ready to be placed in the loom for weaving. For filling yarn the last process for long chains is known as quilling, when the yarn is wound on filling bobbins, or quills.

The object of quilling, is to transfer the yarn forming a long chain in a suitable form to be inserted in the shuttle at the loom. A quilling ma-

chine consists of two main sections, one section resembling the beam part of an Entwistle beaming machine which supports the section machine, while the other section is a substantial framework, supporting a number of tiers of spindles. A quilling machine, like all other machines, can be ordered according to specifications, that is, the number of spindle rails and the number of spindles to a rail can be determined by the purchaser; however, the number of spindle rails usually found on a quilling machine is nine, and the number of spindles to a rail is generally 42. The yarn is drawn from the beam by three metal rolls, and made to pass through a movable reed as on the beaming machine, and for the same purpose, and the tender must continually move this reed to and fro as on the beaming machine. This reed is situated directly behind the three rolls that draw the yarn forward and like the reed at the beaming machine is supported by the sheet of ends.

The quilling spindle is the most peculiarly constructed spindle found on any machine, equipped with

REVOLVING SPINDLES.

The spindle consists of the ordinary blade type with a whorl rigidly attached to it. Next above the whorl is a small pad composed of woolen felt, on which rests a cap carrying a small cone. The bobbin fits on the cone, and a pin in the cap fits a notch into the bobbin. The spindles are driven by means of cylinders and bands, as on any spinning machine, but one point that should be understood about quilling is that the spindle is positively driven but not the bobbin. The bobbin is driven by the cap supported by the woolen felt, and is thus driven by frictional contact that must exist continually between the cap carrying the cone that fits the bobbin and the whorl of the spindle. The principle of quilling is to have sufficient friction existing between the cap and the whorl to drive the bobbin, so that the bobbins can retard when the coils of yarn are being wound on the large diameter of the traverse without straining or breaking the yarn, and increase

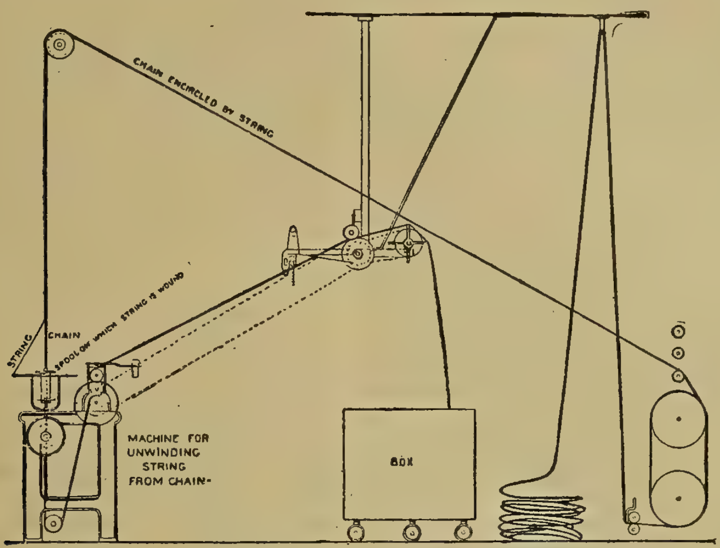


Fig. 59. Unwinding Process for Chain Warp.

in speed when the yarn is on the smallest diameter of the traverse. In order to save a large amount of breakage of ends, the conditions of the spindles are continually watched by the tenders, because they know that the least amount of dirt or yarn allowed to exist between the cap and the whorl, and if the friction between the whorl and cap does not work to a nicety, a great amount of yarn breakage is caused.

On the other hand, if the spindles are well cared for, there is very little trouble in quilling; that is, if the winding and unwinding method is employed in the dye house.

Good quilling depends on the mechanical efficiency that exists between the whorl and cap. If the spindles are not kept clean, trouble is sure to result, although some people seem to think that the speed of the spindle does not affect the tension. Some quiller spindles have been in such condition that the spindles were squeaking, not from the want of oil, but by allowing dirt and yarn to collect around the whorl of the spindle.

When the yarn is allowed to accumulate between the whorl and the spindle rail, the speed of the spindle is affected, while on the other hand when the yarn is allowed to collect between the cap and the whorl, the coils of yarn will work up under the cap and bind it to the spindle. This destroys the necessary friction that should exist between

THE CAP

and the whorl; consequently, if the drive is not positive, or if the yarn is light on the bobbin, breakage of yarn by excessive tension is the result. When the yarn is allowed to collect between the cap and the bobbin, it will accumulate to such an extent as to cause the slot in the bobbin to jump the pin, which results in snarled yarn every time it happens, and in most cases such defects are laid to the dyeing process. When the yarn is allowed to accumulate between the whorl and the spindle rail to such an extent as to cause the spindle to lag behind the surface speed of the cylinder, the result is the production of a soft bobbin. When a weaver receives such bobbins, they are easily discovered, and therefore, they do not put such bobbins into the loom at all, but throw them out into the waste or bad filling box.

On a quilling machine, the spindles must not only have freedom to rotate, but the bands must be kept to about the same tension. Of course, at times a quilling spindle may work to advantage with a slack band. However, the best results are obtained by driving all the spindles to the one speed if possible, and have the friction between the whorl and cap so that it will just create enough tension so as to make a hard nose on the bobbin and also a compact bobbin. The most trouble in a colored mill weave room to-day is brought about where the bobbins are soft, and yet the yarn contains the required amount of twist, and so far as the yarn on the bobbin is concerned, it is just as strong as the average yarn. It must be, or it could not withstand the preceding processes to which it was subject. But as has been said before, mill help should be taught to think as well as work. The following is the reason for such a statement. You will find in many colored weave rooms, when the weaver complains to the overseer about soft filling bobbins, the overseer himself will admit that there is not enough twist into the yarn, and he allows the weaver to throw these soft bobbins into the bad filling box. This is where a little thinking on the part of the overseer will save a lot of money for a plant, simply by informing the help of the following points: he should tell the weaver that a quilling machine at times will wind soft bobbins, no matter how many turns to the inch the yarn contains, and on the other hand, a perfect quilling spindle will make a fairly hard bobbin from soft twisted yarn. The weavers should be taught that the

quiller has nothing to do with the construction of the thread, and that the turns to the inch that exist in the yarn on a bobbin cannot be judged by its compactness after being quilled.

But this is done only in a few weave rooms, and the weavers, and even overseers, seem to conceive the idea that the quilling is to blame for the construction of the thread, which is an impossibility, except when the cap is not allowed enough freedom to correspond with the

PROPER TENSION,

when, of course, the yarn is strained and made weak. An overseer of weaving should not only explain to the weavers how the yarn on a soft bobbin contains the required amount of twist, but they should be taught also that quilled yarn at this stage of manufacture is more expensive than any other yarn.

No. 176.

CLXXVII. QUILLING.

A hard bobbin from a quilling machine is more liable to give trouble in the weaving room than a soft bobbin, and the weaver should be told of this fact. But as in a print cloth mill, if the bobbin is hard and breaks two or three times during unwinding in the shuttle, no fault is found, while on the other hand, if the yarn breaks through a full shuttle spindle or from the shuttle slightly rebounding, if the cop is found a little soft. it is thrown into the waste box.

The best way for an overseer to convince a weaver who is continually throwing soft bobbins into the bad filling box. Is to weave a few of these soft bobbins himself and prove to the weaver that the yarn on a soft bobbin is just as good, and sometimes better than the yarn on a hard bobbin.

Regarding the statement that a quiller spindle when it lags behind the surface speed of the cylinder, through a slack band or dirty spindle, will make a soft bobbin, there are many persons in charge of quillers who will not agree. Most quillers will argue that the speed of the spindle should not be considered, because the friction between the whorl and the cap regulates the speed of the bobbin, and if the spindle does not retard to such an extent that its speed will be less than that of the bobbin, the construction of the bobbin will not be affected. If this is true, why is it that most

QUILLER BOBBINS

are more compact at the finish of the bobbin than at the beginning? The reason is that owing to the bobbin being so light at the beginning, there is not as much pressure between the bottom of the whorl and the cap, and consequently, the cap has more freedom to slip over the surface of the woolen felt, which, of course, decreases the tension, and the bobbin is not so compact at this point. Although this is looked upon as a disadvantage in quilling, it must be said that it is not noticed in the weaving, simply because it requires more tension on the yarn to unwind the coils at the bottom of the bobbin in the shuttle, so for this reason, shelling off the filling is little if ever experienced. Now if the weight of the bobbin affects the friction between the whorl and the cap, and there can be no argument on that point, and if the spindle revolves at a high speed, it must be admitted that it will have more of a tendency to revolve the bobbin at a greater speed, thus increasing the tension.

For the convenience of illustration to prove that the speed of the spindle does affect the tension, let us assume that the speed of the bobbin is the same as that of the spindle when the guide wire is at the smallest part of the traverse, when, of course, the bobbins must revolve the fastest at this point.

Assuming that when the vertical rods make their quick upper movement, the bands slip when the guide wire is at the smallest part of the traverse on the top of the bobbin, it is obvious that the ends would

slacken and no tension on the latter would exist. On the other hand, if the spindle is made to revolve at a greater speed than that of the bobbin, the tension is increased to a certain extent. Although the difference is slight, it will cause a soft bobbin, which is the cause for the best of the yarn to be thrown into the bad filling box. The art of quilling is all in the spindles, and for this reason they should be kept in good condition.

a filling wind. As on the filling ring frame the guide bars instead of the rail, are raised a little higher at each traverse, which builds the yarn a little higher up on the bobbins at every traverse, so that it can be unwound from the nose when in the shuttle. The movement of the guide bars is the same as the movement of the rail on a filling ring frame, that is, the builder motion gives the guide bars a quick motion for one traverse

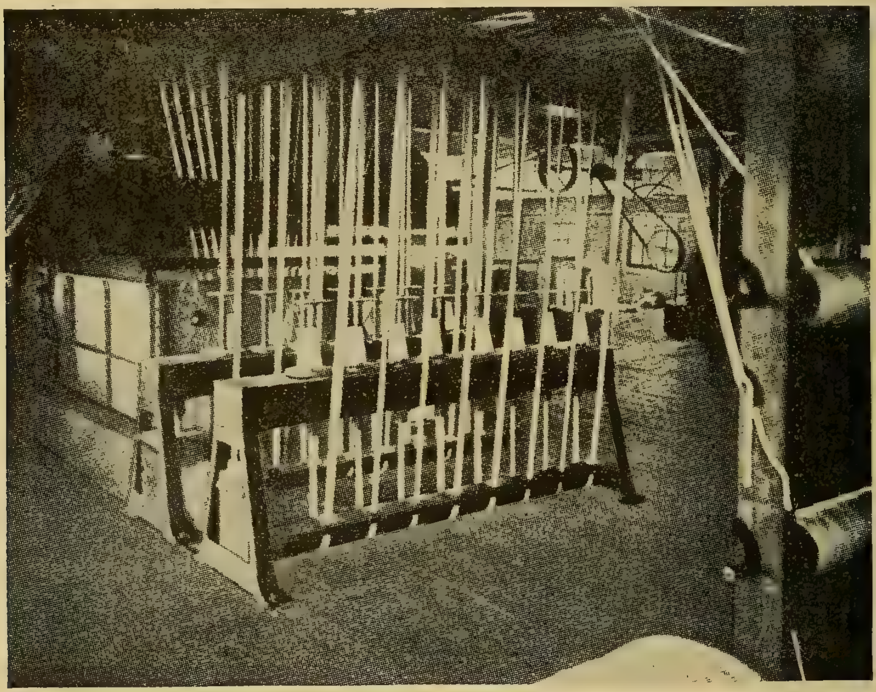


Fig. 61. Machines for Unwinding the Chains.

The yarn on a quilling machine is guided on the bobbins by guide wires attached to inclined bars, directly in front of the bobbins.

The inclined bars are supported by vertical rods operated by a builder motion that gives them a vertical reciprocating motion corresponding to the length of traverse required in winding the yarn on the bobbins. The builder motion is almost the same as that on a ring spinning frame for

and a slow motion to the other. The object of this is the same as on the ring frame, to bind the previously wound coils of yarn to the quill so that the coils will be locked.

There is also much argument among mill men as to what way the guide bars should be given

THE QUICK MOTION.

There should be no argument on this point on a quiller, because it should

be clear that the guide bars will equalize the tension by having the guide bars make their quick movement unward. It should be seen that if the guide bars have their quick movement downward, the tension on the yarn will be very great, which is sure to result in the breakage of ends, because it is obvious that the tension on the yarn is greater as the yarn approaches the largest diameter of the traverse, and if the guide bars

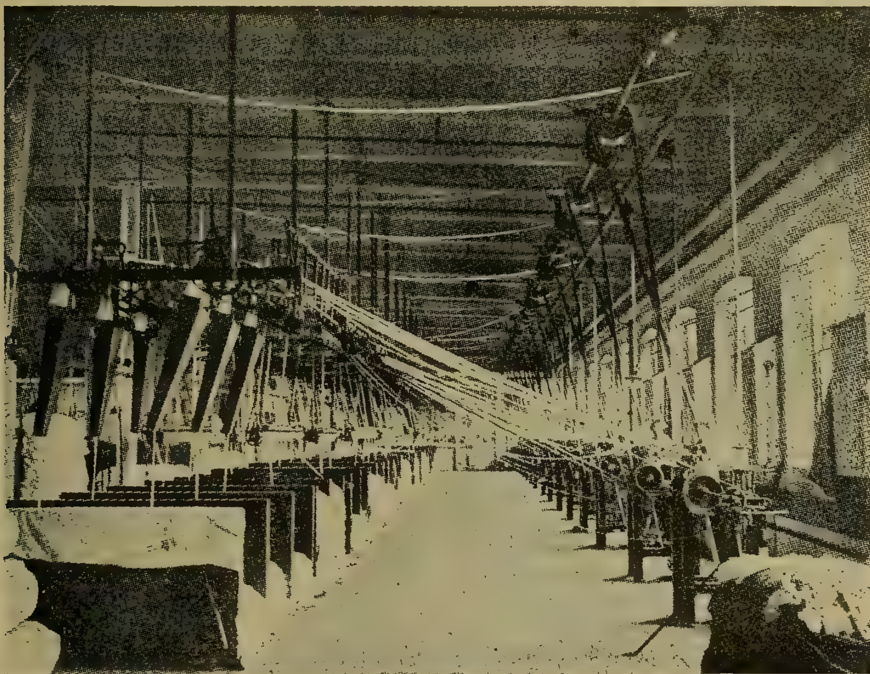


Fig. 60. Winding Chains in the Dyehouse.

are given their quick motion downward we have two extremes. On the other hand, if the guide bars are given their slow motion downward, the speed of the bobbins is gradually checked, and thus the tension is more equalized. Again, when the guide bars are given a quick upward movement, it relieves the tension somewhat, which enables the bobbins to increse their speed. This is desired to enable them to take up all the yarn brought forward. Warping and quilling machinery requires careful attention, and the aim in these departments, as in all others, should be to obtain quality first and then quantity.

One point that should be remembered in the management of these departments is that more and better work can be obtained by not having excessive speeds. Any person in charge of these departments can obtain high speeds on any machine, but just as soon as

THE PROPER WORKING SPEED

is exceeded, the quality of the product deteriorates, and the man who makes good is the man who knows the proper working speeds. To all cotton mill managers the word twist means the number of turns to the inch in the yarn. But in American

textile manufacturing in general, the word twist applies to a ply yarn composed of two or more differently colored yarns. So before the twisting operation is explained, it is necessary to have some knowledge about the classification of yarn. The subject of yarn opens up a very wide field, because not only do the series of machines or processes for preparing yarns vary according to the material that is to be operated on, but different series of machines. However, a brief description of the various kinds of yarn will now be given. Single drawn yarn is known as carded and combed yarn, which was previously explained.

They are named according to the different series of machines the stock passes through, while other yarns derive their name according to the material from which the yarns are manufactured. When yarns are classed

ACCORDING TO MATERIAL,

they are divided into three divisions, namely, vegetable, animal and mineral substances. As the above three divisions are often twisted together, the following general classification is given: 1. The material and various classes of material and the numbers made from each, taking into consideration also the various qualities, growths, also varieties of the material and its suitability for constructing various yarns. 2. The method of their preparation, which varies often even in yarns made of the same material. 3. The material used to give the thread a certain appearance. 4. Forms in which the yarn is put up for the market or for a succeeding process which has been explained 5. The general use of the yarn for different purposes. Cotton yarns are those made from an indigenous product of all intertropical regions, and consists of fine cellular hair attached to the seeds of plants belonging to the genus gossypium, natural order Malvaceæ. These plants which supply the raw material for our greatest industry, and for the clothing of all nations, are ranked among the most valuable of nature's productions. In American

TEXTILE MANUFACTURING

and commerce, the fibre from these plants is known simply as cotton, and although it is known as cotton in English-speaking countries, by some people it is known as cotton wool; in French, cotton; in German, banwolle; Spanish, algodon, and in Italian, cotone. When a yarn is said to be made from one-inch of American cotton, it means that the average staple is one inch long, and produced from the many varieties of cotton grown in the United States of America. The writer has found very few carders in his travels who understood the difference in cotton by its name.

We often hear the remark that Egyptian cotton is much harder to work than any other cotton, especially in the combing. Why is this so? It is simply because the staple is grown in Egypt, in a different climate, and for this reason, the cotton should be left opened for at least a week before using.

Egyptian cotton, when examined in the natural state, can be readily distinguished from most other cotton by its brownish color. Egyptian yarns are generally made of low numbers, especially for hosiery purposes, because the fibres are very strong for their size, and very smooth, from which a solid strong thread can be made.

Although most of Egyptian cotton is used for hosiery purposes, it is often spun over 100s for sateen strips and other designs in the shirting and other trades, and for this reason only, a bale or two is generally used at a time, and owing to it being used separately, it is utilized as soon as the bale is opened, and for this reason, it is hard to work.

SEA ISLAND COTTON

works better, because it is grown on the islands off the coast of South Carolina, and Georgia, and also on the main land in districts near the ocean, especially around Florida. Sea Island yarns are, as a rule, made very fine, in some cases as high as

400s, although, like Egyptian yarns, they are sometimes spun for special purposes into low and medium numbers. Sea Island cotton is spun with worsted in many worsted mills without difficulty, owing to the length of its staple, which in some cases is as long as 2¼ inches. Peeler yarns have a very white appearance, and are produced from a long staple cotton, and can be spun as high as 100s. Allenseed yarns resemble peeler yarns and are both grown around the Mississippi river. No carder or spinner should have any trouble in determining where the cotton is grown, because this can generally be traced by the tags on the bales, and if possible, the staple grown in one state, and the cotton from another should be mixed together.

Peruvian cotton yarns are seldom spun, and although there are many varieties, the rough Peruvian is chiefly used, and spun with wool for the production of merino or similar yarns. Peruvian cotton is just as suitable for a blend with wool as the Sea Island cotton is for a blend with worsted.

No. 177.

CLXXVIII. COTTON YARNS.

Peruvian yarns are seldom spun over 20s, although the staple of the cotton is long enough to enable fine numbers to be spun; but this is seldom done, because the fine yarn would be rough, which is never desired in cotton manufacturing. Surat yarns are made from East Indian cotton, and as this cotton is never used in America, no description need be given. Chinese and Japanese yarns are the same as Surat yarns, only a little cleaner and whiter. They are never used in America. When a yarn is spoken of as a waste yarn, it means that the waste produced, such as fly, strippings, etc., is respun, only the number of operations being reduced as compared with the ordinary list of processes. Waste yarns are always spun into low counts. When the material is respun, a roll now on the market, known as a fancy and described in these articles, should be attached to a card between the flats and doffer. Cotton yarns are spoken of as fine, medium or coarse, but misunderstood for the simple reason that in a fine goods mill, 40s would be considered a coarse or medium yarn, while in a bag or blanket mill, it would be considered very fine yarn. Often in a mill considered to be running coarse numbers, the finest yarn is only 36s, and the superintendent will say that they run fine work. The reason for this probably is because they formerly worked in a bag or blanket mill where the yarn is found generally very coarse. Still, it looks bad for a superintendent to make such a statement, and for this reason,

MILL MANAGERS

should know a more general definition of these terms. Yarns below 30s are considered coarse, 30s to 60s medium, and from 60s upward, as fine yarns. Managers should also understand the classification of yarns according to the purpose for which they are intended. For instance, if a purchaser orders a weaving yarn, it is understood that it is to be woven into fabrics. Of course, there are two distinct classes of yarns for weaving purposes, namely, the warp and filling, and to most all readers, it is well known that the warp is used lengthwise in the fabric and the filling crosswise. Still there are many overseers in knitting mills who could not explain the purpose of weaving yarn. The same can be said about overseers in cotton cloth manufacturing mills, only, of course, they know that the yarn is to be knitted by its name, but they know nothing about how knitting yarn should be constructed. It is for this reason that the different definitions and classifications of both material and construction of the yarn are explained. It is often that a mill man is taken from a cotton cloth mill to a knitting mill, and the same is true in case a mill man is taken from a knitting mill to a cotton cloth mill, and as a rule, they are lame in both cases, simply because the construction and purpose for

which the yarn is intended is not understood by them. Now as to the difference between

KNITTING YARN

and weaving yarn. Knitting yarns made from cotton are almost always mule spun with less twist, and are usually made from longer staple cotton than would be used for the same numbers of weaving yarns. Knitting yarn must be as free as possible from all impurities, and to do this it must be well carded and combed. In fact, the above is what, as a rule, distinguishes knitting yarns from other yarns by its fineness, cleanness, slack twist and at the same time full, round and even appearance.

Cotton knitting yarns are produced for a great variety of purposes, and consequently are made in a wide range of numbers, in both carded and combed yarns, from 5s to 30s, although as in a cotton mill, weaving yarns of finer or coarser numbers than above are made in many cases. Knittin yarns, like weaving yarns, are almost always supplied in single yarns, but as in a cotton mill, certain kinds of goods often call for two-ply and sometimes three-ply yarns, which are used for reinforcing the threads of knitted garments where the extra wear comes. On the other hand, warp yarn for fabrics is usually spun from longer staple cotton which contains more turns to the inch than the filling yarn, and must be made as strong as possible so as to stand the strain and chafing of the harnesses in the weaving. The staple for the warp yarn can be rather harsh without affecting the

FEEL OF THE CLOTH

much on some weaves, but with the filling yarn, this is different, and although the filling yarn does not require as strong staple, the wise manager will use a soft pliable cotton for his filling, which will give the cloth a smooth face, a move that keeps many mills running, while others using a poorer grade of cotton are stopped. It is not necessary to use high-priced cotton for the filling, as all the waste should be used up again in the filling, simply because the waste is very smooth. Double roving has been advocated for the above reason, pointing out that the yarn made from double roving does not require the same amount of twist to the inch as yarns made from single roving. Buy a harsh strong cotton for the warp, and a soft pliable cotton for the filling, and it will be found that when a yard or two of cloth is sent to the purchaser as a sample, especially sateen cloth, made from the above stock a large order will generally follow.

Why is it that the smoothest faced cloth is made from warp and filling yarn spun on a mule?

This is common in Englanc, although the ring frame is being more widely used now for warp. The up-to-date mill manager tries to get under the buyer's skin by contructing a piece of cloth that will have

A GOOD APPEARANCE

and a smooth face as well. All practical men know that a wrong sizing preparation will make the cloth unmerchantable in many cases, and surely we must admit that the twist in any mill is as important as the dressing. As a rule in cotton cloth mills very little ply yarn is found, but when ply yarns are used, it is to strengthen the selvages, and for leno threads, lapper threads, centre selvages, and for other special effects in the fabric. It is often that weaving yarn is plied five times, and in some cases, more than five for special leno and lappet weaving. A man coming from a knitting mill to take charge of a cotton mill must understand the contruction of the yarn for the purpose intended, and the same with the man from the knitting mill. The difference is great but easily learned, because the calculations are the same in a knitting mill as in a cotton mill, but before the amount of twist is inserted in the yarn it must first be known for what purpose the yarn is intended. The most twisting is found in carpet mills,

and the yarn produced is called carpet yarn. It is spun first on ring frames, and afterwards twisted into ply yarns either 2-ply, 3-ply, 4-ply or 5-ply. As this yarn must be dyed, it is reeled into 72-inch skeins, cross-reel. Carpet yarns are about

THE CHEAPEST YARNS

made, and a low quality of cotton is used in their manufacture. The most common number that is made in carpet yarns is number 8s. The most peculiar ply-yarns are known as upholstering yarns, and in making the ply strand is very slacky twisted with a few turns to the foot, instead of a few turns to the inch as in the ordinary ply yarns. No. 178.

CLXXIX. LINEN.

Most of the fibres spun into yarn resembling cotton yarn are generally known as flax, and are procured from fibres obtained from an inner layer of bast in the stem of the flax plant. The cultivation and preparation of the linen fibre, and its treatment until it reaches the market as a commercial product, are dealt with under the name flax. The term flax yarns would be more accurate, but the term linen has always been so commonly known and used that it is generally accepted. Heckling is the first preparatory process that consists not only in combing out, disentangling and laying smooth and parallel the separate fibres, but also serves to split up and separate into their ultimate filaments the strands of fibre which, up to this point, have been agglutinated together. The heckling process was until recent times done by hand, and it was one of

FUNDAMENTAL IMPORTANCE,

requiring the exercise of much dexterity and judgment.

The broken, ravelled, and short fibres which separate out in the heckling process form tow, an article of much inferior value to the spinner, and one that has fooled and is fooling many people buying linen at the present time. The proportion of tow made in the process of heckling varies according to the skill and knowledge of the heckler. It can be seen that the linen thread is made either from line flax tow, the line flax, of course, being the best fibre, which varies from 12 to 30 inches in length.

Linen yarns can best be distinguished by the fact that line yarns are very much finer in number than tow yarns, and have a smoother and more even construction. Hemp yarns are constructed from the fibres obtained from the bast portion of the stem of the hemp plant grown in India and in some parts of the United States. Hemp yarns are chiefly used for canvas, coarse bagging and other cloth that requires great strength.

Many people are confused by taking Manila hemp, out of which the bagging for cotton bales is made for the real hemp fibre. There is much difference in the two fibres, as one is a leaf fibre, while the true hemp is a stem fibre. Jute yarns are also made from the bast of a plant.

Jute, like the

LINEN AND HEMP YARNS,

are classified according to whether they are line yarns or tow yarns. Ramie yarns are also produced from fibres obtained from the bast of the stem of a certain Asiatic plant, which is also grown in other countries including the United States.

Ramie or China grass is a plant of the nettle family, and is grown principally in China, although it can be grown in any semi-tropical country. The process by which the ribbons are obtained is simple. The Chinese first soak the stalk, which grows about three-eighths inches in diameter and from 24 to 60 inches long, in a running stream for a couple of days to remove the outer bark. Then, by a knife held on the thumb, the stalk is stripped of the fibre which comes off in the shape of ribbons. It is then dried and afterwards compressed into bales about the size of cotton bales and weighing from 600 to 800 pounds. The plants yield about six crops year-

ly, the second and third crop being considered the best. These ribbons, landed in New York, cost from six to ten cents per pound, depending on the crops.

The yarns made from ramie differ from those made of linen or cotton, in that they possess a far better degree of lustre when dyed or bleached, although they are inclined to be a little more hairy than linen. The specific gravity of Ramie is less than that of linen, and hence for the same size in diameter of yarn, there is about one-third more yardage and at the same time, the strength is nearly the equal of linen. Weight for weight, ramie is stronger than linen.

The principal uses for ramie yarns in this country up to the present time have been for gas mantle yarns, and the millinery trade. However, due to its superiority over linen and cotton for many purposes, varied uses are now being developed.

All the above yarns are made from vegetable fibres, and their classification is simply and easily made by burning a portion of the thread, and when it is made of a true vegetable fibre it will flame. Next to cotton, wool is the most important of all textile fibres used by mankind. Wool is a modified form of hair, distinguished by its slender, soft, and wavy or curly structure, and by the highly imbricated or serrated surface of its filaments.

Most cotton workers conceive the idea that woolen and worsted yarns are made of different material, but both are wool yarns. It is the custom to divide them into these two classifications for commercial purposes. Their classification is also simple and easily made, because in a woolen yarn the individual fibres are mixed and crossed in various directions, so that the surface of the yarn is made rough, although uniform in appearance. It also lacks lustre. In worsted yarns

THE INDIVIDUAL FIBRES

lie smoothly and in the direction of the thread and are parallel to one another.

The surface of the thread presents a smooth and uniform appearance, and generally has a well-defined lustre.

Though the sheep is by far the most important producer of wool, he is by no means the only animal which yields wool employed for industrial purposes.

The alpaca and other allied fibres obtained from the alpaca and its congeners in South America, the mohair yielded by the Angora goat, and the soft woolly hair of the camel are all wools of much industrial importance. Very few people know, even wool purchasers, that the most costly wool is not yielded by the sheep. The most costly wool in the world is that yielded by the cashmere goat of the Himalayan mountains. At what point, indeed, it can be said that an animal fibre ceases to be hair and becomes wool it is impossible to determine, because in every characteristic, the one class by imperceptible gradations merges into the other, so that a continuous chain can be formed from the finest and softest merino to the rigid bristles of the wild boar. For this reason, no distinction is made between woolen and worsted yarns, merely because of the length of the wool fibre used in their construction, although a somewhat longer fibre is generally used in the manufacture of worsted yarns. No. 179.

CXXC. BLENDING AND USES OF YARNS.

Wool yarns, like cotton yarns, are as a rule divided according to the use to which they are to be put, such as clothing wools, braid, lustre, etc., also according to the breed of the sheep.

PURE WOOLEN

yarn means a yarn composed of all wool or worsted. Shoddy yarns are all wool, but are made from a mixture in the raw stock, the shoddy being obtained from soft woolen rags.

Mungo resembles shoddy, but it is inferior to shoddy, owing to the hard milling it undergoes. The term extract means fibres obtained from rags or goods composed of vegetable and animal fibres. Yarns are generally

mixed at the twisters, although they are often mixed in the ring frame, and sometimes when the cotton staple is long enough it is carded and combed with wool to be spun into worsted yarns. This is done, of course, to cheapen the cost of production, and it is with regret that I must say a pure woolen yarn is hard to find. Take, for instance, the finest of worsted mills and you will find cotton blended with the yarn in process. This is why the term mixture of yarns is used, which means that two yarns made from mixtures of different colored wool and also from mixtures of wool and cotton, wool and shoddy, wool and mungo, wool and extract, or wool, cotton and silk, which is generally twisted on universal winders.

Cotton is also carded and spun with shoddy, not so much to cheapen the cost of manufacture, for cotton is generally as expensive as some shoddies, the reason why it is introduced here being to

GIVE STRENGTH

or spinning qualities to the stock. All persons acquainted with the shoddy business know that as a rule the majority of the staple is very short and unable to stand the drawing-in spinning, and as it would make the cost of the yarn too high to put in enough wool to give that required strength, cotton is put in for this purpose.

The writer wishes to be understood when he says that pure woolen yarns are hard to find. He does not mean that all-wool yarns are not manufactured, because it only takes a visit to the woolen mills in Lawrence, Mass., and also the woolen mills in Olneyville, Providence, R. I., to see some of the finest worsted yarns produced in the woven so that when it dries it will will only find about one yarn in a hundred on the market that is composed of pure wool. The best way to determine whether a garment or cloth is composed of all wool is to burn some of the fibres in each style of yarn, and if a slight flame is noticed, it is not composed of all wool.

ANOTHER TEST

for a buyer is to have a solution of 5 per cent caustic soda, and boil a small piece of the cloth five minutes. Whatever is left is cotton or other vegetable fibres. The above is the best method to determine the percentage of vegetable fibres in a fabric. As wool will dissolve in the above solution, the percentage of shoddy cannot be determined except by experience and judgment. In the first place, a fabric or yarn with shoddy in it is easily detected by its feel. Besides, if a small portion of yarn is dissected, any shoddy which exists can be discovered by its short staples. Cloth made of all new wool is softer feeling than one containing shoddy, for the latter has lost that new, soft, springy feel peculiar to wool, besides when the yarn is dissected the fibres are found very long. When a yarn is composed of 90 to 97 per cent cotton, it is known as a Vigogne yarn.

First-class woolen yarns are produced by spinning the yarn directly from the spool produced at the card, and the range of numbers of this class of yarns is from ½ to 12-run. The French system of drawing differs from the English system, because in the French

NO TWIST

is given the slivers. It is a rubbing process and the yarn is spun on mules. It is not necessary that only long-stapled wool be used for the production of French-spun yarn, as in this system comparatively short fibres can be worked. Uncombed worsted yarns mean the same as the carded yarn in the cotton system; that is, the yarns are prepared by a sequence of processes from which the combing process is omitted.

As in carded cotton yarn, they are more uneven and irregular in construction than the true worsted yarns, and they resemble a spindle drawn yarn. Silk yarns are classified according to the method of preparation. Thrown silk yarn is produced by processes of reeding and throwing, while

spun silk yarns are spun from waste raw silk.

SILK YARNS

are chiefly used for weaving, organzine being used for warp, while a very coarse cotton or worsted yarn is used for the filling.

When a silk tram is used for the filling, the term organzine means to the silk worker the same as warp to the cotton worker, while the term tram means weft, or filling. There are a few mineral yarns, asbestos yarns being the principal one. Asbestos fibres are often found two inches in length and have usually a coarse and white appearance.

The chief value of fabric made from asbestos yarn is that it is incombustible and can stand intense heat. Asbestos is found in the United States, Canada and other countries. Scoured yarn means that the wool of which the yarn is composed has been subjected to a preliminary scouring to remove the dirt and the natural grease

MERCERIZED YARNS

are those which have been treated while under tension with a caustic soda solution. This gives a silky lustre to the thread. Printed yarns are those that have passed the effect of the printing process and received short dabs or long blotches of color impressed on the threads at intervals.

Polished or glazed yarns have passed through a process of applying a dressing material and then by a brushing process a high, glossy polish is attained. Gassed yarns have been passed rapidly through a gas plane thus causing the projecting fibres to be singed. This is done because the fuzzy construction of the yarn is a disadvantage for many purchases. Gassed yarns are not damaged by such a process, because the passage of the thread is so rapid that the heat burns only the loose ends.

PREPARED YARNS

are those which have been put through a dressing process. Conditioning yarn is a process of damping or steaming the yarn to cause the strands of twist put in the thread to become fixed so that when the yarn is unwound it will not snarl. This happens when the yarn is dry, if no device is attached to the loom to prevent it, especially when the yarn is excessively twisted in any counts. It is sometimes made wet and shrink and crimp the cloth. Again, when the filling is damp, it enables the picks to be driven closer to one another. Mock twist yarns are spun from two different colored rovings

All types of novelty yarns could hardly be given. Most manufacturers sell them by number instead of by name. To give the reader an idea as to what are classed novelty yarns he is asked to stop and think how a broken gear on a spinning frame will cut the yarn at intervals. This would be classed as a

NOVELTY YARN

if such a construction was intended. Some novelty yarns are uniformly uneven yarns; that is, they have thick and thin places alternating regularly. Novelty yarns are often twisted together, and sometimes a common yarn is twisted with a novelty yarn.

Common yarns are twisted with novelty yarns known as bunch yarns, which are composed of small bunches called slubs. Slubs are bunches of untwisted yarn, and for this reason the kind of yarn is twisted with very fine common yarn. This allows the yarn to taper off to a thin thread, and at the same time hold the loose fibres together.

Up to the present time, it is safe to say that there have been over 15,000 styles of novelty yarns made. It must be understood that the different designs result chiefly from different colored yarns and combination of materials that are constructed singly or twisted together. Novelty yarns, as a rule, are used in extremely small quantities and made relatively heavy. Yarns are plied together chiefly to give greater strength and resistance to friction than is found in single yarns. There is

MUCH ARGUMENT

about the claim that ply yarns are stronger than single yarns of the same diameter. Some writers claim that the

twist in the single yarn has very little or nothing to do with the strength of the double yarn. Continuing they claim that the above is very easily demonstrated by the fact that spindle bands made from roving are as strong as if made from yarn. Although the writer is willing to admit that the difference in the breaking strength is not very great in case a long staple cotton is used, it must be admitted that, since a ply yarn consists of two strands, it is not so liable to be pulled apart if subjected to any process that may fray its surface, or by a strain brought on the yarn. The above subject can be compared with that of double roving, because it must be admitted that a ply yarn has double the doublings, if the single strand of the double yarn has been prepared by the same sequence of processes.

When the staple is very short, the

PLY YARN

is much stronger than the single yarn of the same relative diameter. Again, any overseer of twisting will so arrange the work that the strands will be twisted in the opposite direction to that in which they are spun. This will again largely reduce the tendency toward the separation of the fibres in the other threads if more than two-ply. From the above it can be seen that a ply yarn composed of two or more single yarns has more strength than one single yarn of the same weight. For the above reason ply yarns are used extensively as extra threads in the weaving, chiefly for warp, where the yarn is called on to stand much strain. For instance, they are often used for selvages, since the ends at this point must also withstand a lateral pull toward the centre of the cloth. Again, in some mills where the ply and single yarn are woven from one beam, a great amount of strain is continually on the ply yarn. This is, of course, understood by most all weavers, because it is well known that a coarser thread will contract more. The writer is willing to admit that the above method is wrong, still you will find that in some mills the above method gives very little trouble.

In the knitting industry ply yarns are required for different purposes such as give the garment a special appearance or feel, and to be used in such parts of the fabric as heels of socks, where the most wear occurs. Ply yarns are also used for lace making, in which it is essential to have a fine, strong, even thread. For the same reason, sewing thread is plied, also crochet, mending, machine, covering, seaming and other yarns. Twisting is done on machines of various types, the type depending on the condition of the yarn when it is twisted and also the method employed to insert the twist. For instance, in some mills, for reasons stated elsewhere, the yarn is twisted in two conditions, dry and wet, and the machines are so named, dry and wet twisters. Ply yarns are twisted on various types of machines, known as the flyer twister, ring twister and twiner. The flyer twister resembles a speeder flyer and spindle, only, of course, is much smaller. The ring twister resembles the ring frame, having spindles, rings and travelers, and the principle is the same. A twiner is on the same principle as the mule, on which the ply yarn is constructed into cops for the shuttle. Besides, there are different combinations of processes, and varieties of forms from or to which the yarn is twisted. No. 180.

CXXCI. TWISTING.

For instance, you must have suitable arrangements when twisting from cops or spinning bobbins directly to the twister bobbin at one process. Twisting from spinning cops on to a twiner cop, spooling to double-headed spools, twisting directly from these to the twister bobbin, winding two or more threads on a parallel tube at a doubler-winding machine and twisting directly on to the twister bobbin, all call for a different organization. The

OBJECT OF TWISTING

is to form the ply yarn by inserting a sufficient amount of twist in the required direction, but it should be understood here that although the twist

calculation for twisters is the same as the ring-spinning frame, no drafting takes place on the twisters.

As on the ring spinning frames, there are two general styles of rings, one being used for the dry twist, and the other for the wet twist. On the ring frames, the flanges are the same whether single or double ring, while on the twisters, the two styles differ to such an extent, that the shape of the rail must be changed. The traveler and ring for dry twisting is on the same principle as the ring and traveller on a spinning frame, while on the wet twisters the ring is forced into the hole cut out of the rail, so that one side of the ring will form the lower flange, and the other side of the ring the upper flange. With such an

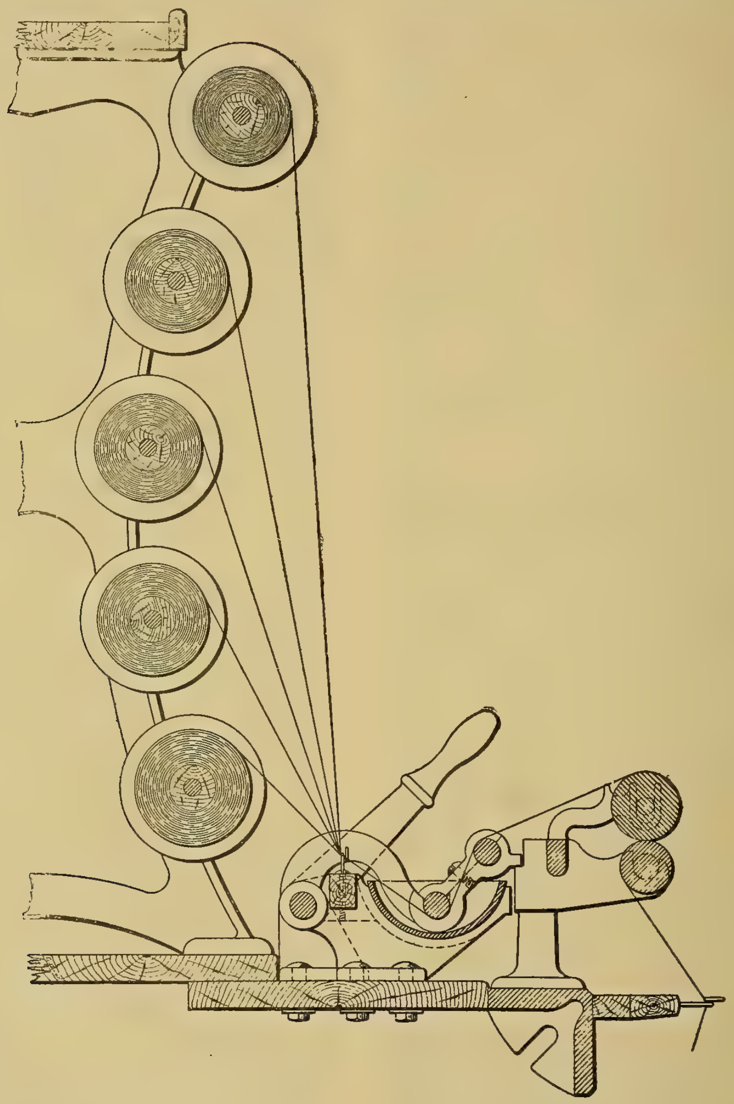


Fig. 62. Section Through Wet Twister, Showing Water Pan.

arrangement, it can be seen that the rail bears on the

CENTRAL SURFACE

of the outside of the ring. The traveller is so shaped and long enough to fit and run on both flanges at the same time. One good point about wet twisters with the rail, ring and traveller described above is that instead of turning the rings, the rails are made reversible, and may be turned over when badly worn. From the above, it does seem that this could easily be done on ring-spinning frames.

When a heavy and a large bobbin is in use on the twister, a brake is applied that can be operated by the knee. By such a brake, the attendant presses the face of the brake, and this in turn forces an arm which has a friction pad. As soon as it is brought into contact with the spindle, it is quickly stopped. The builder is so much like the builders on the ring frames, that what was said above can be applied here. The reader must, of course, use judgment concerning the difference in the taper or any other points when constructing a bobbin that may be disturbed by the increased diameter of the thread. Having a device to raise the top rolls on a twister is a great advantage. It saves many roller laps, which means a saving of waste and also good yarn. In case an end of the

TWISTED YARN

between the rolls breaks, and the top roll is not raised, the yarn laps around one of the rolls until cut off and pieced up by the tender. These laps should be avoided as much as possible, because twisted yarn around a roll is difficult to remove, and besides it cuts and marks the rolls.

For this reason, stop-motions are in most cases applied to prevent any more yarn being drawn from the creel after an end breaks at the front of the twister. Twisters equipped with this so called stop-motion can be run at a greater speed, which means a larger production, with less waste and better quality. The stop-motion is a simple one; it consists of a metal plate supported by the journal of the top roll. Attached to this arm is a small tongue that is fed in between the rolls when the end breaks. A long curved wire extends from the arm outwards, and passes downwards, carrying at its end an eye for the yarn to pass through. A small lip that comes into contact with the bottom roll prevents the tongue from being fed through the rolls. The tension of the yarn prevents the small tongue from being fed. When the end breaks, the weight of the curved wire causes the tongue to come into contact with the top roll and raises it, which prevents the rolls drawing any more yarn.

The arm is usually extended at its rear portion, so that when it shows above

THE ROLLS,

the tender knows that an end is broken. Of course, when such a device is applied to wet twisters, the material of which the device is composed must resist rust. Again, the wire and arm must be adjusted to suit the tension for a wet twisting traveller. It must be understood, also, the contrivance for wetting the yarn immediately before it is twisted must also be of suitable material to resist rust. The chief object of wetting the yarn is so that the single yarn forming the ply thread will lay closer. It is claimed that wetting the yarn produces a more solid, smooth, and slightly stronger thread. It only takes a glance at each thread made in the various systems, to realize the amount of difference. The short fibres project from the thread when ply yarns are dry twisted, while when wet twisted, the fibres are laid more closely, which prevents any short fibres from projecting from the surface of the ply yarn.

There are

THREE KINDS

of wet twisting, namely, American, English and Scotch. In the American system, the number of ends necessary to form the ply thread are passed through a guide wire, and then under

a glass rod in a trough of water to the rolls. A glass rod is used also in the English system, but a handle is attached, and the glass can be raised for dry twisting; the passage of the yarn is the same. In the Scotch system, the bottom roll comes in contact with the water in the trough, and the rolls are mounted on arms adjusted to a horizontal rod, by means of which the rolls can be raised from the trough for dry twisting.

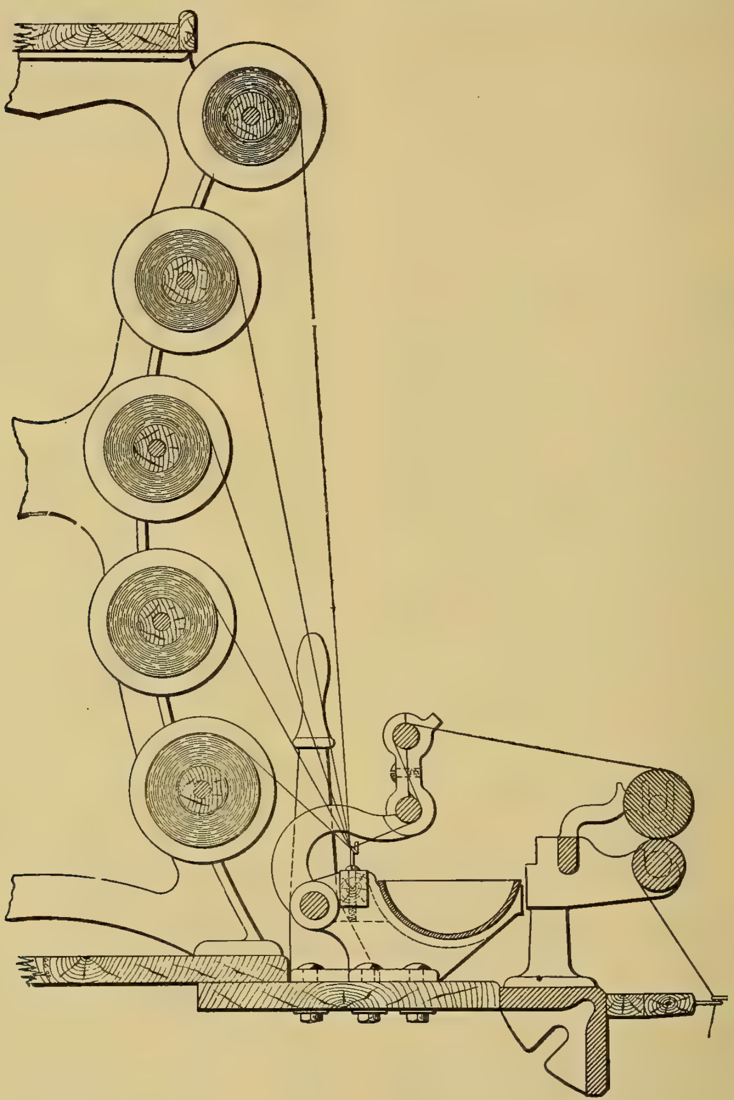


Fig. 63. Section Through Wet Twister With Glass Rod Lifted Out of Pan.

An important point for any person having charge of twisters is to be sure and have the correct constant for each kind of twister, because although the diameter of cylinders seldom varies on ring frames, it is different with twisters. Not only does the

diameter of the cylinders vary, but also the diameter of

THE WHORLS,

and this, of course, calls for different gearing.

The amount of twist to be inserted in a ply yarn is usually determined by the buyer, when ordering, and the amount of twist is gauged by what is known as a multiplier. A multipler means a constant, which, when multiplied by the square root of the counts of the single yarn, gives the number of turns per inch. This number is governed by the purchaser's experience, and for this reason, there is much variation, and this is the cause for so much dissatisfaction in the ply-yarn trade. A good rule to follow is to use a small number for soft yarn, and a large number for sewing thread, harness yarn, etc. To give an idea how a buyer can tell how many turns should be put into the yarn of a certain number, let us assume in this case that the buyer uses six for a multiplier, and the number of yarns is 80s. 80 divided by 2 equals 40. The square root of 40 equals 6.33 times 6 equals 37.98, or practically 38 turns per inch, that should be in 80s yarn. All manufacturers of ply yarns should ascertain from the buyer when he orders, whether

THE MULTIPLIER

is to be considered as multiplying the square root of the counts of the single yarn, which forms the ply thread, or of a single yarn that would be equivalent to the completed ply yarn. It can be seen from the above example that the multiplier used for a single yarn that would be equivalent to the completed yarn would be much larger.

The production of a twister is generally figured by the diameter and speed of the front roll, and this, of course, only gives a theoretical production. Like obtaining the production on other machines by the speed and diameter of the front roll, an allowance must be made to compensate for the amount of time lost in stopping the frame for doffing and various other purposes. This makes the above method only approximately correct. The shortest way to obtain the closest production on twisters is to subtract the amount of waste made on spooling and twisting from the spooling production, provided, of course, that the

PROPER METHOD

of finding the production on the spoolers is employed, as was explained. Sometimes the production per spindle is demanded, which is obtained by the following rule:

Assuming that a twister turns out 480 pounds per week off 240 spindles when two strands of 20s are twisted together, what would be the number of pounds turned off each spindle? 480 divided by 240 equals 2 pounds. The above rule is simple, and used when the machines have no clocks, but when clocks are used, the following rule is generally employed: Divide the number of hanks per spindle by the resultant count. The above would give 20 hanks per spindle, 20s divided by 2 equals 10. 20 divided by 10 equals 2 pounds per spindle. The above is simply given to show what useless figuring is sometimes done in a mill. What is the use of figuring the production of any machine, and carrying the example to three decimal places, as is frequently done in textile schools and text books, when at the same time you ask the student to allow 5 to 20 per cent to compensate for the amount of time lost in stopping the frame for various purposes? We must admit that it is not only time wasted, but misleading, because you will find many graduates who will use only such methods. Besides the variation in the strand amounts to more than a whole number in most cases, so what is the use of using so many decimal places, when the production can easily be found with the above short and more accurate methods?

There are few flyer twisters, and as this method of twisting is mostly used only for linen, hemp, and jute yarns, no description is given. The

chief point in the management of twisters is to watch and see that the

CORRECT NUMBER

of ends is being passed by the rolls to form the ply yarn. This is important, and is the cause of much trouble, especially in thread mills. The more times the yarn is plied, the easier the defective places will get by. For instance, in case of only two-ply, if one end has broken, the other end will also break in the front of the rolls, because in the ordinary method of twisting, with the twist in the reverse direction to that in which the yarn is spun, it is impossible for one end to run without the other, as the reverse twist untwists the single yarn, which causes the fibres in the strand to separate, and the end is sure to break. It can be seen that in case of a ply higher than two, it is possible for one of the single ends to break, while the others pass forward to the bobbin with one end missing. As stated, the

STOP MOTIONS

are valuable for the prevention of such defects in the yarn, and the quality of the yarn or thread is always of a better grade when they are used.

When an end breaks and laps around the rolls, it is as a rule quickly discovered by the tender, even if the machines are not equipped with stop motions, but as it may sometimes break in the creel, it may run a long time before it is discovered. When it is discovered by the tender, she will take a chance and let it go, because she knows that combed or dyed yarns of which ply yarns are composed, are very expensive, and knows the consequence of making too much waste, so for this reason, she will let it go. The numerous twister tenders letting such defects go has been often the cause of thread companies losing large orders. Another point about twisters is to keep the bands as tight as possible, in order to avoid trouble with the purchaser, because a slack band on a twister shows up badly. No. 181.

CXXCII. SIZING THE WARP.

Cotton manufacturing owes a great deal of its success to the correct method of sizing warps. The object of sizing the yarn is to harden its outer surface and give it strength enough to pass through the operation of weaving without breakages. The warp ends undergo so much chafing while passing the harnesses that if the threads are not properly coated, there will be trouble.

In some mills, little attention is given to the sizing. A certain amount of sizing material is weighed and dumped into so many gallons of water and boiled. Regardless of the size or grade of the yarn, the kind of size is never changed.

Sizing warps requires experience and judgment to prevent trouble. Cotton yarns require a well prepared solution before being put into the loom, and the method and proportion of the sizing depends upon the class of cloth to be woven. The process of sizing to some extent lays the fibres along the surface of the warp yarn. This reduces the amount of fly at the loom, and the decrease friction that would result if the fibres projected from the surface of the yarn.

The above is a point that must be considered in most cases, and one that is the basis of much trouble in the finished cloth. For instance, if the thread is sized too hard, the cloth will have a harsh feeling. Instead of remedying the defect in the sizing, the ring spinner is often blamed for having too much twist in his yarn. He is therefore forced to take out twist, when perhaps there is not enough in the first place. This makes trouble in the following processes. In the weaving, the yarn will continually be snapping, because in such a condition, it depends chiefly on the sizing for its strength.

FOR SHORT FIBRES.

If the fibres are short, and it is desired to lay the fibres along the surface of the yarn, more size in proportion to the weight of the yarn is required, while on the other hand, if

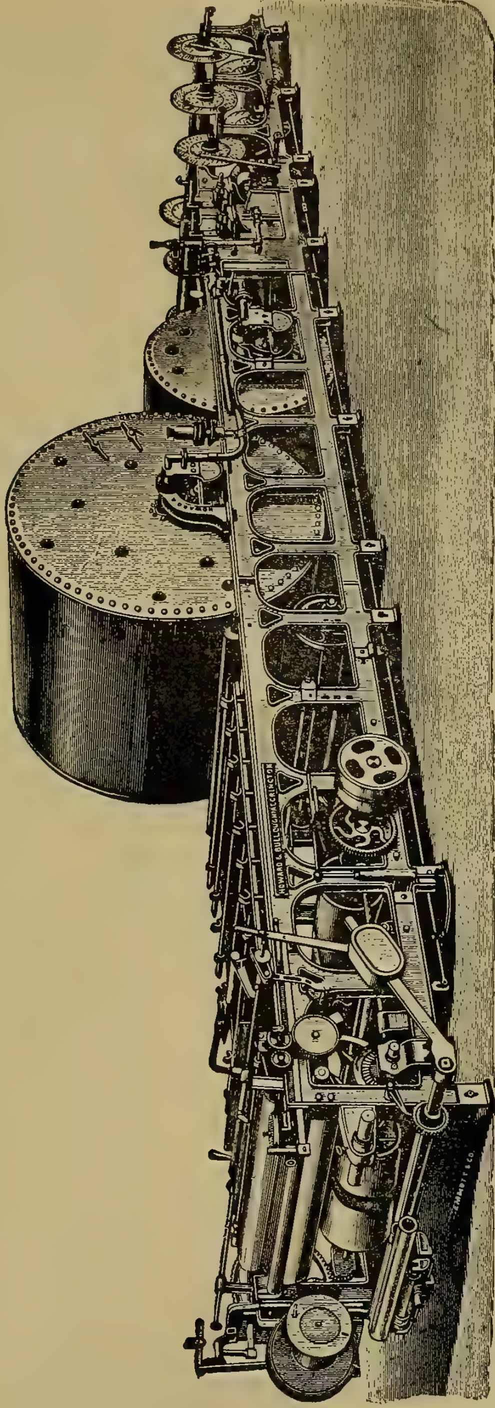


Fig. 64. Cylinder Sizing Machine on Slasher.

it is desired to have a soft, smooth face finished cloth, less size in proportion to the weight of the yarn should be used. A yarn made of long staple cotton does not require the same sizing as yarns made from short fibres. Of course, if the warp yarn contains a large amount of waste, a medium or heavy size to get the yarn through the loom must be used.

Sizing is used for many purposes. For instance, some mills use the size not only for strengthening the yarn to enable it to withstand the strain and friction of weaving, but it is used also to improve the appearance of the cloth by making it fuller.

Fine yarns, say, about 80s to 100s, are often prepared and sized on what is known as dressing frames, but the machine chiefly adapted to treat the warp yarn as it comes from the warper is known as the slasher. The chief defect found on most slashers in operation to-day is that of having the steam admitted to the size box on only one side of the box. In this way, the solution on the side of the box where the steam enters is boiled more than that on the other side. The above causes trouble in the weaving room. To overcome this, many mills have equipped their size boxes with perforated pipes that are made to circle the box. How many mills have men in their slashing departments who take the above points into consideration? This is often left to the slasher tender's helper. When conditions in the weave room are very bad, questions may be asked. If the tender says that it was a bad barrel of tallow or waxine, the matter is forgotten until more trouble occurs. An investigation may then be made, but it is too late, or at least too late to remedy the amount of yarn that has already been dressed.

KINDS OF SLASHERS.

There are various kinds of slashers that differ in construction, and for this reason, each type will be explained. Slashers are named after their construction, namely, cylinder slashers and hot air slashers. The hot-air slasher is seldom used, and differs from the cylinder slasher only in the drying arrangement. The yarn in this type of slasher is dried by being passed through a hot-air chamber that contains many coils of pipes, through which steam circulates. The chamber being closed, the air within reaches a high temperature, and the sheet of yarn is guided through this chamber, and emerges well dry. The beams are placed in a creel in this type of slasher, and the ends from these beams are passed over guide rolls. The yarn passes through the size box under the immersion roll, next between the first size roll and squeeze roll, and then between the second size roll and squeeze roll, and then to the hot-air chamber. The operation is the same with both types of slashers, and the only difference lies in the drying arrangement.

One point that is overlooked on slashers is the amount of steam injected in the size box, which tends to thin the size. In order to overcome this, many manufacturers have a steam jacket installed at the bottom of the size box, no steam being admitted to the solution. This method of heating size is the best and only method to keep the size of uniform consistency.

SUPPLY STEAM ON ONE SIDE.

With the size of box equipped with a steam pipe, supply steam on only one side of the box, the force of the steam is continually driving the heavy ingredients away to the other side of the box. Besides, the water from the condensed steam is more apt to remain on the same side of the box. In this way, the warp ends are sized heavier on one side than on the other, and as was explained elsewhere, the yarn is not evenly dried. If heat enough was supplied to dry the yarn on the heavy side, it would burn the yarn on the light side, and if there is only heat enough to dry the thin side, the ends on the heavy side will remain damp and cluster together. In order to suit both sides, the slasher tender from experience will divide the heat, and for the above reason, when

a new style of goods is dressed, a slight difference in the weight of the yarn and number of ends give trouble.

When a size box is equipped with perforated pipes, it is different. As the solution is boiled to the same degree, the experienced slasher tender can reduce the amount of steam, and in this way, there is little danger of burning the yarn. Although the above method is not the best, it will, with proper attention, give good results.

When the steam does not enter the size solution, no attention need be given to the size box. The temperature of the jacket is the only point to be watched. With this method, even if the weight of the yarn or the number of ends is changed, it is not liable to give trouble.

What makes size solutions cake? This trouble is caused by introducing steam at one side of the size box, by not supplying steam uniformly, or by excessive use of tallow.

A SUITABLE SOLUTION.

In order to be able to arrange a suitable solution to suit all markets, it is necessary to understand the nature of the materials that form the solution. It is also necessary to understand all kinds of raw stock. It is a good plan to have the carder trained, so that he will advise the overseer of the slashing department when the nature of the stock changes. It often happens in a cotton mill that two and three kinds of yarns can be detected on the beams by their color; some will show very white, while others will have a bluish yellow, or gray color, which indicates that the stock coming in is changing.

In arranging the solution, the first thing to consider is the size of the kettle. This is where a mistake is made too often. For instance, you will often hear slasher tenders ask one another how many pounds of ingredients they use to a batch of size. The reply is frequently given without mentioning the capacity of the kettle. The kettles generally used for the same number of slashers are generally the same size, but in some mills, a larger kettle is used. The usual and best method is to have a small kettle for each slasher.

In preparing the solution, the best plan is to always reduce the ingredients of any mixing under consideration to the basis of 100 gallons of water, instead of the size of the kettle. Then consider the quantity of dry starch, weighing substances, softening substances, and other ingredients. The proportion of the ingredients to be used and the method of mixing them is the most important matter.

IT IS SAFE TO SAY

that there is no subject connected with cotton manufacturing where such a variety of opinions exist, and where so many different methods are employed, as in size mixing. You will find that a different solution is used in almost every mill, but you will find the best results in those mills where different mixings are provided to suit the several classes of cloth.

Size mixing is like twist in the yarn. It must be governed by local conditions. The location of the slasher room, so far as this affects the humidity, must be considered.

In preparing size, the following points should be considered: (1) Medium numbers in a cloth of light sley and pick can be woven with a light size. (2) If the warp has to be woven with a fine reed make the solution stronger. The reason for the extra amount of size should easily be seen, since the ends in each case are brought closer together, and the friction on them is largely increased. (3) For a heavy pick, the warp ends pass through the harnesses and reed more slowly, and are more subject to chafing. (4) The twist per inch in the yarn must be considered, because a coarse thread, being loosely twisted, tends to fray in the harnesses and reed more easily than a lighter yarn properly twisted, and for this reason requires a stronger size. (5) The kinds of raw stock should be considered. No. 182.

CXXCIII. MIXING.

A mixing is weakest for coarse yarns, and the percentage is reduced in proportion to the counts. If the cloth is woven with a heavy sley and pick, even though the number of the yarn is the same, the solution must be made heavier, and if the yarn is very fine, the solution must also be made heavier. In order to obtain the best results, and have good weaving with the least amount of yarn breakage, it is necessary to have several mixings to suit the class of cloth to be woven. Often you will find different arrangement in looms to separate the entangled ends that are caked together, and the superintendent will brag of such a device, instead of giving his attention to the sizing. The writer has in mind one mill where the size mixing is so well prepared that the weavers are running ten and twelve looms without stop-motions.

A good size mixing can be distinguished from a poor one in many ways; for instance, its adhesive property, which is the leading qualification, can easily be determined by the substance falling off at the loom. Such a case proves that too much starch is used to form the body of the mixing. The principal ingredients are potato starch, corn starch, sago flour, wheat flour, which are used to form the body of the mixing. Softeners which are used to avoid harshness, and at the same time preserve the softness and pliability of the yarn, are tallow, japanese wax, glycerine, castor oil, palm oil and soap. Tallow is no doubt the most useful, but is little used in some mills, owing to it being so easily affected by atmospheric conditions.

WEIGHTING SUBSTANCES

are used in medium and heavy sizing to add weight that the adhesive substances cannot give. Perhaps the most useful material for a weighting substance is china clay, known to some mill men as kaolin. This is free from grit, very smooth, dead white and uniform in color, and besides it has a great attraction for moisture. Chemicals are introduced to destroy any micro-organisms and vegetable life that may exist, and thus prevent the decomposition of the size or the growth of the mildew.

In some cases soda is used to prevent iron stains, while turpentine is used to cut up the softening materials, so as to get a better blend. It should be used only in small quantities, and the mixture should never exceed over a pint of turpentine per one hundred gallons of water.

The following table is given to be used for an approximate amount of starch, and softening materials, that should be used to each one hundred gallons of water for pure sizing. It should be understood that it is impossible to give a definite solution that can be applied to all fabrics.

Counts of yarns.	Heavy starch, pounds.	Sley & pick softening, pounds.	Medium starch, pounds.	Sley & pick softening, pounds.	Light starch, pounds.	Sley & pick softening, pounds.
10s to 30s....	45	5.5	40	5.5	35	4.5
30s to 45s....	55	6.5	45	5.0	40	5.0
45s to 70s....	75	8.0	60	6.5	45	5.5
70s to 100s....	88	12.0	78	10.0	63	7.0

In using the above table for the first batch, the warps sized should be examined in the looms to ascertain whether thew weave satisfactorily or not, then according to the result, the size should be either weakened or strengthened, until the right solution is obtained for the class of goods in question. The ingredients used should be so that when the same style of goods is to be slashed, the right solution can be quickly determined.

How long should the sizing be boiled before using? Economy in the use of sizing material depends greatly upon the boiling. A comparatively weak sizing will give the same results as a stronger mixing, if well boiled.

GREAT PRECAUTION

must be taken, however, not to cook it badly. To be able to boil the solution properly requires much experience.

Use of China clay necessitates the addition of other materials to aid the clay and make the yarn pliable. The following is for a 50 per cent mixing to 100 gallons of water: Wheat starch, 300 pounds; clap, 150 pounds; tallow, 60 pounds; chloride of zinc, 24 pounds, and chloride of magnesium, 18 pounds. About three or four ounces of aniline blue should be used to improve the color. For a 100 per cent size, the following will give good results: Starch, 340 pounds; clay, 340 pounds; tallow, 70 pounds; chloride of zinc, 40 pounds, and chloride of magnesium, 40 pounds. For a 150 to 200 per cent size, the following will be found suitable: Wheat starch, 560 pounds; China clay, 1,600 pounds; tallow, 1,600 pounds; soap, 20 pounds; soda, 30 pounds; chloride of magnesium, 40 gallons; muriate of zinc, 20 gallons, and aniline blue, one ounce.

When the above sizes are made, the wheat starch is steeped alone for three or four weeks, and then the muriate of zinc and soda and heat applied, is added. The clay and other ingredients are, of course, mixed separately in the size kettle and boiled, then the two compounds are boiled together. Even with good size, there is often trouble. For instance, the trouble may be in the size kettle, in the size box, in the squeeze rolls or in the drag roll. No. 183.

CXXCIV. SIZE KETTLES.

We will first consider the kettle. Kettles are generally situated on a platform at a higher level than the size box, so that the solution will fall by gravity. The kettle consists of a cast iron body, and should be lined with copper.

The use of turpentine to blend the sizing solution, when the fault lies in the speed of the mixing paddle, is a common mistake. When there is trouble in the blending, the first thing to do is to time the paddle shaft, instead of using turpentine. The paddle shaft should revolve at least 100 revolutions per minute to blend the solution properly.

Another defect that will injure the sizing of the yarn is having the size rolls out of level. Recently, the weavers of a large New England plant were having much trouble through the above defect. The warp ends on one side of the warps coming from one of the slashers were all clustered together, and different devices were resorted to in order to separate the ends before reaching the harnesses. The trouble was hard to locate, but it was found that the size rolls on this slasher were not level, and most of the size was going more to one side. As the squeeze rolls rest upon the size rolls, they too were out of level, and this caused the yarn to be more heavily sized at one side of the machine than at the other. Consequently, the size was not pressed out enough by

THE SQUEEZE ROLLS,

and the heat from the two cylinders was not great enough to dry all of the yarn. Some of it left the cylinders slightly humid, and was pressed together by the presser roll on the weaver beam. Care and judgment are required to cover the squeeze rolls. The squeeze rolls on a slasher are common iron rolls, usually about six inches in diameter, and the first layer of cloth is either glued or thickly coated with white paint. Some writers advise using three qualities of cloth, namely, coarse, medium and fine.

The object of covering the squeeze rolls with cloth is to cause the size to penetrate the yarn. In order to accomplish this, the selection of the cloth to cover these rolls is an important consideration.

Do not be in too much of a hurry to change the quality of starch; stop and reason things out, and if all parts are examined and found to be in perfect order, then it is time to blame the quality of the solution. There are many kinds of prepared solutions on the market that give trouble. The best method is to use the purest of starch and prepare the solution.

It is not always necessary to use a new cloth for covering a squeeze roll

when the outside layer becomes stiff. This can be remedied by taking the cloth off and soaking it in water. Unnecessary expense can be saved by giving these small details proper attention.

The best method when covering the squeeze rolls is to have one man in charge of the belt shipper, so as to run the slasher as slow as desired. A man should be on each side of the roll, and as the cloth is being wound, it should be given a lateral pull toward the outside of the roll, so as to prevent its puckering up at different places on the surface of the roll. The above is the cause for humid blotches found on the sheet of ends on a weaver beam.

When

THE CLOTH PUCKERS

up it prevents the other portions of the surface from coming into the necessary contact with the size roll, and the size is allowed to follow the yarn at every revolution of the squeeze.

After the squeeze roll is covered, a level should be placed on its surface to see if it is level. There are few slasher tenders who do this, because they claim that it has very little to do with even sizing; nevertheless, uneven size rolls have, in the past, and are to-day giving trouble in many mills, and the above is one cause for the trouble.

Trouble exists often in the weave room on account of poorly dressed warps. What an overseer of slashing should do when he receives complaints from the weave room is to examine every part of each slasher before the solution is blamed.

No matter how good the weaver is when the warps are poorly sized, he is as helpless as a carder or spinner when poor stock is in process. The basis of good weaving lies in well-dressed warps. Are warps weighed after they are sized? Is it not a fact that they are seldom weighed, and still the amount of size applied to a warp may vary 15 or more per cent? When the cloth is found to be light or heavy in the cloth room, is the sizing given any attention for the cause? After the filling is first weighed, then the warp yarn, and if they are found to be right, the looms are examined. If the looms are in good condition, and the cloth shows on the heavy side, in most every case the filling is made lighter, even when it is on the mark. What is the result? As soon as the sizing varies on the light side, the cloth, of course, becomes too light, and the filling is

AGAIN MADE HEAVIER.

Cloth thus constructed will show light and heavy in different portions, and this is many times the cause of losing large orders.

Can you put too much cloth on the drag roll? If you do, what effect does it have? I have never yet seen the above question properly answered. The object of the drag roll or friction roll, as it is sometimes called, is to pull the yarn forward from the size roll. The size rolls are usually the same diameter as the drag roll, and they are geared so that the drag roll will take up just the amount of yarn delivered by the size rolls. For the above reason, a very thin cloth should be used to cover the drag roll. Some argue that at least three layers of cloth should be added to the drag roll, and this is done at the present time in many mills, the reason given being that it is necessary to cover this roll with three layers of cloth in order to prevent the warp yarn from being cut by the measuring roll, and also the guide roll, with which the drag roll comes in contact. Although the above is true to some extent, you will find that one layer will give better results, simply because the drag roll has an evener surface when one layer is used, and there is sufficient cloth to protect the yarn from being cut by coming into too close contact with the measuring roll and guide roll.

Can you put too much cloth on the drag roll? My answer is, yes, because when there is much cloth on the drag roll, the yarn is pulled forward at a greater speed than it is delivered by the size roll.

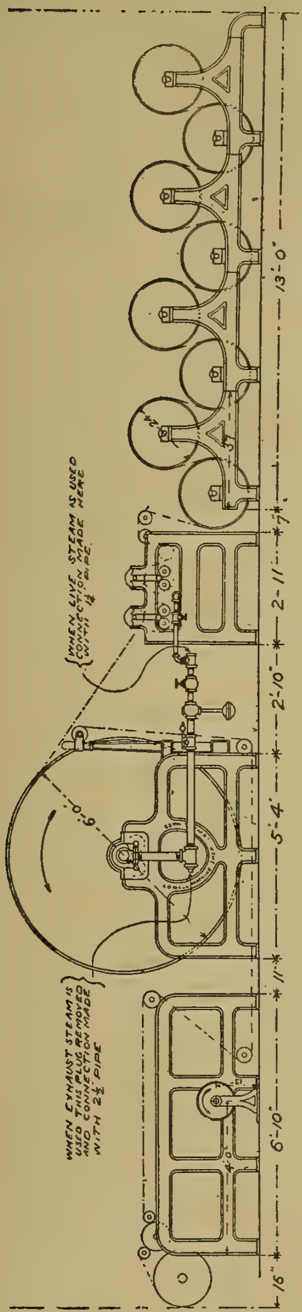


Fig. 65. Sectional View of a Cylinder Slasher and Creel.

When too much cloth is added to the drag roll the yarn must be stretched, because the drive of both the size roll and drag roll is positive. Cotton yarn, stretched when in a humid state, loses much of its elasticity, and the warp ends are continually snapping at the loom.

In many cotton mills, the following rule is adopted, but it is not correct, however, unless the ends show a little slackness. The rule is to have the drag roll one-eighth of an inch larger in diameter than the size roll. The writer himself has advocated this rule, but only for an approximate idea. Using the above rule, the drag roll would have an increase in surface speed of almost one-third of one inch, since 3.1416 times 6 equals 18.8496, and 3.1416 times $6\frac{1}{8}$ equals 19.2423.

No. 184.

CXXCV. DRAG ROLL COVERING.

No rule can be laid down for covering the drag roll, except that the yarn should not be stretched. When the yarn is stretched on a slasher, its appearance is considerably affected. The fibres will be found to protrude from the body of the yarn, and if the warps are for sale, they may be rejected. On the other hand, many manufacturers increase the tension between the size roll and the drag roll, so as to make a softer finished cloth, but it must be said that this is a poor place to obtain an oozy yarn, as it is termed, because the amount of yarn breakage at the looms offsets the advantage.

One defect that exists on nearly all slashers is that of having the exhaust to carry away the steam directly over the cylinders. An arrangement could easily be made so that the steam could be taken away directly over the size box, and in this way the cylinders could be kept dry. It is often the case that the exhaust does not work as it should, and the condensed steam falls on the surface of the cylinder, which prevents the heat of the cylinder drying the yarn.

When a slasher is stopped for a time without having any steam ad-

mitted to the cylinders, the steam that is already in the cylinder will condense. If this water is allowed to remain or accumulate in the cylinders, it is impossible to obtain good work. In some mills, the buckets do not work as they should, and a certain amount of water is always in the cylinders. There are generally

THREE BUCKETS

in each cylinder to carry away this condensed steam, and they should be kept in order at all times.

When these buckets get out of order, they give warning, the water which collects being quickly discovered by any experienced slasher tender. Sometimes the buckets are in perfect order, and the cause is in the pipe that runs from the buckets. However, when water collects in any slasher cylinder, the machine should be stopped, and repairs made at once. Every revolution of the cylinder that contains water is turning out work that will later give trouble in the weaving.

The exhaust water is conveyed by the exhaust pipe to a steam trap. The production of a slasher is determined from the measuring roll that rests on and is driven by the drag roll. A gear on the end of the measuring roll drives the measuring motion, which indicates the number of cuts that passes through the slasher. As on the chain warpers, a bell rings at the completion of every cut. All slashers are provided with a mechansm, known as a cut marker, that stamps a portion of the sheet of yarn at the end of each cut. This arrangement often causes trouble by using too much dye when stamping. The stamp sometimes is heavy enough to soak into another layer of yarn, so that it is hard to know which is the correct mark. By

CAREFUL OPERATION,

this trouble is readily eliminated. When more than one slasher is operated in a mill, each slasher tender should have his own marking color, and in this way bad work can be easily traced.

For finding the production of a slasher, it is best to first find the speed of the drag roll. This is obtained by multiplying the speed of the driving shaft by the number of teeth on the change gear, and dividing the quotient by the number of teeth on the large drag roll gear. Example: Find the speed of the drag roll, when the driving shaft is making 280 revolutions per minute, the change gear containing 30 teeth, and the gear on the drag roll 100 teeth. 280 times 30 divided by 100 equals 84 revolutions per minute. Knowing the speed of the drag roll and its diameter, the number of yards slashed is obtained by multiplying the circumference of the roll in inches by the number of revolutions, and then dividing the results by 36. Example: Assuming the drag roll to be six inches in diameter, 84 times 6 times 3.1416 divided by 36 equals nearly 44 yards.

To get the best results the drag roll should take up exactly the same amount of yarn that is passed forward by the size rolls. In many cases there are too many layers of cloth on the drag roll, and this causes much snapping of the ends in the weaving. In the example we found that the slasher turns off 44 yards per minute, but it must be understood that this is only the length of one end, and in order to get

THE PRODUCTION

the number of ends in the warp must be multiplied by this length, and then divided by 840 and the number of yarn. Assuming that the above number of yarn is 30s, and the number of ends in the warp is 2,200, we have 2,200 times 44 divided by 840 divided by 30 equals 3.84 pounds of warp yarn per minute, not deducting the percentage of size added to the yarn. If there is too much drag, the yarn is made brittle, and this is often thought to be due to the cylinder carrying too much steam.

When covering the drag roll, the old cloth should be scraped off, and the surface of the roll made perfectly smooth before laying on the new

cloth. A closely woven thin cloth should be used to cover this roll, and when the slasher is started, attention should be given to the sheet of ends to see whether it is too tight or not. Sometimes an extra layer of cloth must be added to this roll when running very fine yarn, which is composed of long fibres, as they give unusual elasticity. What is the result of poor sizing? In the first place, it will cause an undue wear on the heddles of the harnesses, and also on the reed. The yarn itself will become worn, and cause weak places in the cloth. The

WEAK PLACES

in the cloth will often tear in the operation of dyeing or bleaching.

Second, if the yarn is fine, and has an unusal amount of elasticity, a number of the threads forming the sheet will kink. These kinked threads will get entangled with the adjoining threads during weaving, and cause what is known as a smash in the loom. These kinked ends will also find their way to the cloth, and protrude from its surface.

Third, if the solution is not properly arranged, the size will shed off at the loom. This gives the weave room the appearance of a flour mill, the looms and floor being full of starch.

Fourth, crossed threads in the weaver beam, which in most cases is caused by contracting or expanding the reed, when the width of the warp has been miscalculated, or by having a larger number of ends in one dent than in others, causes the ends to roll over each other, and become entangled. There are various ways to overcome and remedy the above defect, but the best way is to learn how to prevent these instead of wasting time in their remedy.

When a breakout occurs on a slasher, the help often pull off 15 or 20 yards of yarn. Four or five yards should be sufficient. The amount of waste made in this way should be carefully checked and reduced as much as possible.

When weaver warps are carelessly handled, the ends, instead of remaining in a solid sheet, become loose and crossed. This is the cause of many mistakes in the drawing-in process. Many slasher rooms have a certain number of spools running on filling boxes, or in racks, instead of taking the trouble to properly arrange the intended number of ends at the warpers. Some overseers of spooling will break up a beam by using from 20 to 100 ends, and then allow this beam to lay around the slashing room uncovered, until it is unfit for use. In most mills where the practice of breaking up the number of ends on beams is carried on, they do cover the beam, and then again, use this beam when a set lacks the necessary number of ends. In every case, a certain amount of yarn is wasted.

No. 185

CXXCVI. WASTE.

The first thing to do when the number of ends is arranged, especially for a new style of goods, is to figure the number of ends intended in the cloth. Then, instead of changing all the warpers, change only one; this is an easy matter. For instance, let us suppose that we are running 360 ends on each warper, and this number just suits the style of cloth now in process; that is, say that the number of ends on each weaver beam is 2,520, or in other words, it takes just seven beams to make the set, and we wish to change to another style, to contain 2,200 ends. 2,200 divided by 360 equals 5 beams, and 400 ends over, so add 40 more ends in one warper, in order to make up the set.

After the section beams are placed in the creel, the process known as leasing is introduced. Leasing should not only be done at the commencement of each set, but should be done

AT FREQUENT INTERVALS

during the running of the set. The leases employed at the slasher are the same as those already explained in connection with ball warping. These bands are inserted at the creel between the sheets of yarn at each point where the sheet of one beam comes in contact with the sheet

of another. For instance, with eight beams, four leases would be laid across the warp yarn from above, and three from beneath, seven leases in all for eight beams. The leases that are to be laid on the sheet from beneath are first placed on the floor in position for insertion, and those that are to be laid from above are laid on the creel.

The slasher is run very slowly when this is done, and the first lease is placed between the sheets of the two beams farthest away from the slasher, which we will call the first two beams. After this band has passed the point over the lease positioned on the floor, this lease is raised from the floor, and inserted between the two sheets of the second and third beam. Then when this lease has passed forward the required distance, the third lease is placed above between the third and fourth sheets, and so on, until the whole number of leases are inserted.

Every lease when inserted should be given a slight pull, so that each end will overhang the beam flanges to avoid the possibility of any ends of the leases being drawn in the sheet, but just before the sheet enters the size box, the ends should be folded over the edges of the sheet, to again insure against their being drawn out or getting entangled when going through the slasher. When the bands have reached the front of the slasher, what are known as split-rods are inserted by splitting the lease and forcing the split-rod through the lease. The band is pulled out, and the rod takes the place of the lease. The band that first appears in front of the slasher is the first lease that was inserted between the sheets from the first and second beam, and the split rod nearest the slasher, which we will call the first rod, is inserted as described in its place, thus dividing the warp in

TWO EQUAL SHEETS.

The yarn from the bottom beams occupies a position above the rods, while the yarn from the top beams occupies a position below the rods. The sheets from the four top beams are beneath the sheets from the four bottom beams, and in this manner the sheets are divided and kept separated.

The process of slashing colored warps for fancy colored work is important, and must be in charge of a thoroughly competent man, because one hour's carelessness will cause weeks of worry and annoyance to a weaver, besides causing bad work, which necessitates this cloth being put into seconds. This lessens the production in the weave room, and the bad work at this stage of manufacture is more costly than when running white work. The importance of good sizing should easily be seen from the fact that one slasher usually supplies from three to five hundred warps for the looms.

For the sizing of

COLORED WARPS,

it is not advisable to run all the colors through one size box, because the colors that are not fast will tend to run and affect the colors of other warps. For this reason, many mills install two size boxes, and arrange for the white warps and fast colors to pass in one box, while the other colored warps are passed through another. This arrangement changes the method of leasing, and is so complicated that what is known as twisting-in is employed. When running a fancy pattern, the beams running into one size box are placed in the creel together, and the white and fast colored work are also placed together. The lease rods are then inserted in the same manner as when running white work, and then the warps are twisted to their own colors, and in this way the pattern cannot be disarranged. No. 186.

CXXCVII. POINTERS FOR SLASHER TENDERS.

A presser roll is used in slashing machinery to lay the yarn in compact form on the loom beam to insure a hard beam. This roll is held in contact with the surface of the beam and is driven by

frictional contact. This arrangement is the most neglected part of a slasher. You will find many mills to-day where the managers will run these presser rolls from four to eight inches shorter than the inside width of the loom beam. They will oblige the slasher tender to use a filling box filled with weights to shift this roll from one at a constant speed, and to do this requires good judgment. The disks must be well covered with the best of flannel. As the beam increases in size, its revolving speed must decrease. In order not to exert too much pull on the yarn, the friction drive must always be in perfect condition. When the friction drive is neglected,

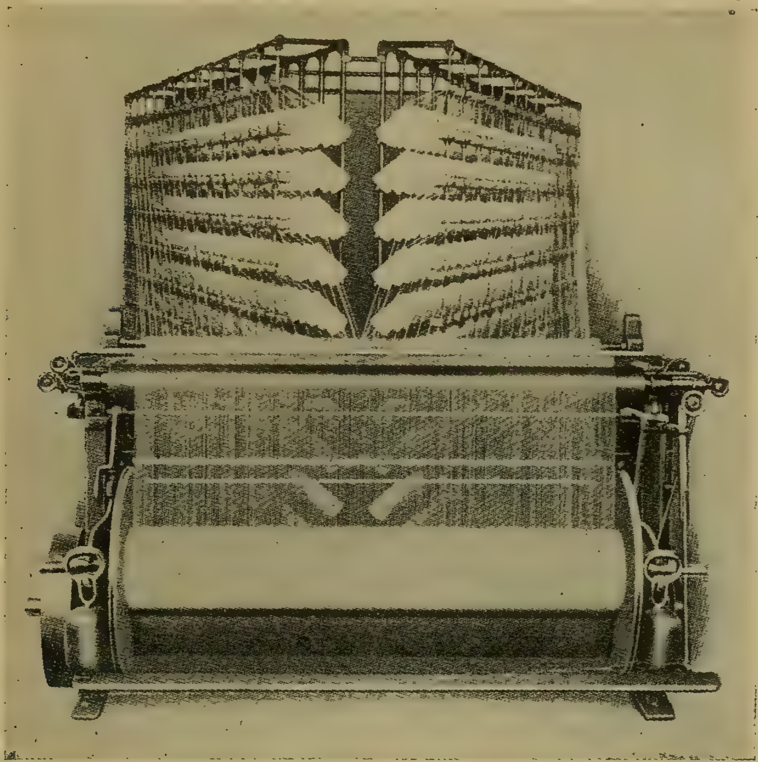


Fig. 66. Warping from Cones.

side of the warp to the other every little while in order to equalize the pressure on the surface of the yarn, instead of buying a few presser rolls to suit the width of the loom beams employed.

The friction drive for the loom beams require much watching and the best of stock should be used. The best kind of flannel gives

GOOD RESULTS.

It should be the aim of all slasher tenders to wind the ends on the beams it will not yield gradually. Instead it will yield in jerks, which affects the yarn in the same manner as having too much cloth around the drag roll. The friction drive is regulated on most slashers by a screw on the side of the disk, and the same attention should be given to covering the disks that is necessary when covering the drag roll. The slasher should be run slowly, and the sheet of ends should be regulated so that the loom beam will not be driven any faster than is necessary to take

up the length of yarn delivered by the drag roll.

Many slasher tenders conceive the idea that this friction will take care of itself, which is very erroneous, for all friction drives must be slightly altered during the filling of the beam. In some cases it is found necessary to make

ADDITIONAL ADJUSTMENTS

of the weight in order to meet requirements.

Why is it that the friction must be altered during the filling of a loom beam? As the beam increases in size any pull upon the ends has a greater retarding effect. This means that the friction drive must be altered to allow for the extra leverage. Many slasher tenders will say that the above is all theory, and that they never disturb their drive from one beam to another. They also claim that their work runs all right. Admitting all this, what about the weaver? Does his work run satisfactorily? If there is much snapping of the ends, the wind is generally blamed. In a mill where the looms are running without trouble, it will be found that as soon as the slasher tender doffs the beam, he will at once regulate the tension. At times the friction disks give trouble

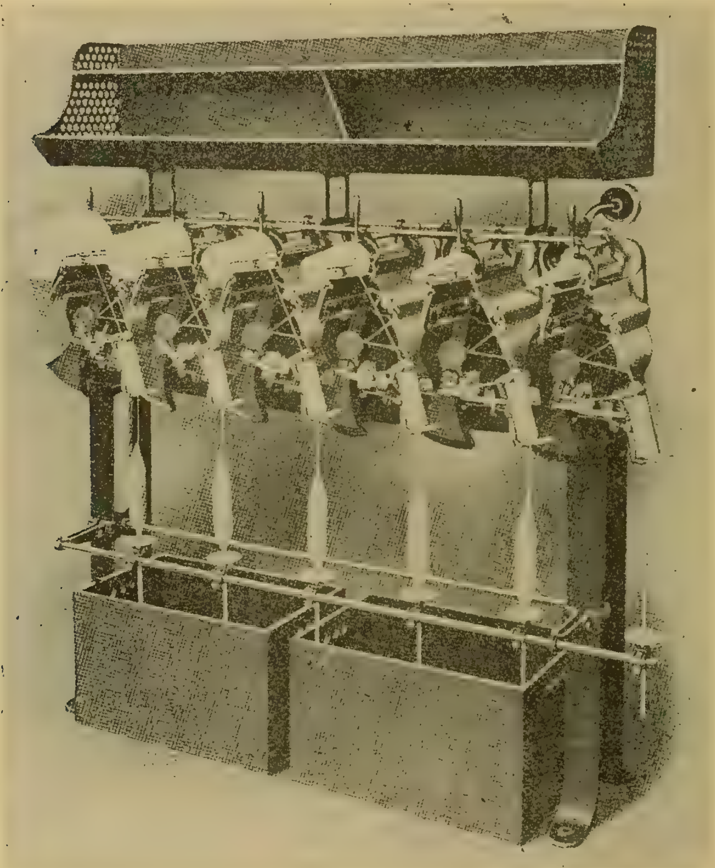


Fig. 67. A Typical Winder.

due to poor covering. This is poor economy, for a great deal of

MONEY IS WASTED

in any mill where the best of cloth is not purchased to cover the friction drive and squeeze rolls.

The writer recently had the pleasure of visiting the Palmetto Cotton Mills in Columbia, S. C. The quality of cloth turned out at this mill speaks volumes for their perfect method of cotton warp sizing. You must pass in the loom alleys more than once to see a loom stopped.

When the section beams are removed from a slasher, the opportunity should be taken to wash the rolls and clean other parts of the machine, in order to produce a clean sheet at the front of the slasher. A slasher should never be stopped more frequently than is necessary during the running of a set, and for this reason, all the cleaning should be done when the beams are changed.

Too often much damage is caused to many ends by the slasher tenders taking a chance to make repairs while the machine is running at full speed. Such practice should not be allowed. Again, many slasher tenders neglect closing the steam valve when they run the machine on the slow-motion pulley, and burn the yarn so that it is difficult to weave the burnt portion of the sheet.

In most mills, it is a rule to start a new set each morning and finish the same day. In some mills where a large number of raps are used on the section beams, the slashers are driven by

INDEPENDENT POWER

such as a small engine or electric motor, and the machine is run during the noon hour or any part of the evening, to enable all the yarn on the section beams to be run through. Such mills are managed by men who have had a practical experience, and they understand the importance of these methods.

When the slasher is stopped at night, the size and squeeze rolls should be washed with cold water, and the immersion roll should be raised out of the solution. The squeeze rolls should also be raised out of contact with the size rolls, because if this is not done, the weight of the squeeze roll will press a portion of the cloth between the squeeze and size rolls to such an extent as to flatten this portion of the squeeze roll. This will cause the squeeze roll to jump at every revolution.

The writer has already explained the disadvantage of filling the beams past the level of the heads, and any manufacturer who wants a great length on his weaver beams, would be well repaid for having larger heads cast for this purpose. He would not have so much yarn falling over the beam heads, or have it become entangled or slack. The argument that a greater length on the weaver beams saves much expense in the drawing-in room, and on the looms, holds good only when the heads are large enough to hold the yarn.

In some mills, the warp ends are divided into tapes by the use of a

STRIKING COMB.

The use of this comb offers facilities for filling the expansion comb, as the striking comb contains the same number of teeth as the expansion comb. When this comb is used the ends are arranged in tapes before going through the size box. The sheet is sized in tapes, and each tape is placed in a space in the expansion comb. This is done before inserting the split rods. When the steam is taken from a connection other than the main steam pipe, the pressure in the cylinders is sure to vary to a large extent, and when the steam runs low, the slasher tender will open the steam valve. As the pressure on a branch pipe may increase faster than that for the entire battery, the operation of the safety valve may be impaired. The writer admits that such cases do not happen often, but slasher tenders must keep this point in mind.

When the steam pipe for the slasher cylinders is connected to the main

steam pipe from all the boilers, this not only precludes the possibility of an accident, but gives a pressure more uniform. This drys the yarn at the same heat throughout the set.

The only

RELIABLE WAY

to find the amount of size that is added to the yarn is to weigh every section beam before they are put in the creel, and also weigh the tail ends of each beam, and deduct the weight of these tail ends from the total weight of the yarn on all the section beams. This gives the exact weight of yarn run through the slasher. Next weigh every empty weaver beam, and weigh the same beam when full, and then deduct the weight of the empty beam. Do this on every beam until the set of section beams is run out, and then find the percentage in the following way: Let us assume that eight section beams, each weighing 390 pounds, are placed in the slasher creels. The tail ends from these beams weigh 40 pounds. We have 8 times 390 minus 40 equals 3,080 pounds of yarn run through the slasher. Let us assume that we weigh every weaver beam from this set and find that the total weight is 3,390 pounds, what is the percentage of size applied to the yarn for the set? Example: 3,390 minus 3,080 equals 310. 310 times 100 divided by 3,080 equals 10 per cent of size on the yarn. The amount of size applied to the yarn should be known by every superintendent, because he can then better judge or figure his warp yarn, when changing styles. In summing up the above, it must be admitted that the success of cotton cloth manufacturing depends to a large degree upon the science and art of cotton warp sizing.

Single yarn as it leaves

THE SPINNING FRAME

is in the form of a cop or bobbin. In many cases, this form must be changed, either to continue the process of manufacture, or to put the product up into suitable condition for dyeing or transportation. Cotton yarns are also often put up in the form of a skein.

The practice of putting up yarns on tubes has been common for many years, but the best and most perfect cone winding has been accomplished only within a few years. Winding machines prior to the early '90s were crude, and many defects existed. Since the early '90s, however, the winding machines have been much improved. At the present time, the winding machines of the best types will lay the coils in perfect alignment, and form a compact, self-supporting package, no matter what form it is given.

Yarn put up on cones or tubes can be conveniently used for many different purposes. The latest types of winding machines are adapted to the entire range of textile materials for which winding is required.

The method of tube or cone winding is similar to the balling attachment that has been previously explained; that is, the cone or tube is placed on the drum instead of a wooden core. In order to clearly understand the latest method of winding, the reader should fix firmly in his mind the method employed to form a ball on a ball warper, as in both cases, the method of guiding the yarn to the core is similar. This is accomplished by means of a traversing motion, which causes the yarn to cross the path of yarn previously wound on the core. The chief differences are that on the winding machines the tension on the yarn can be regulated to suit the compactness of the package, and the traverse motion is worked more rapidly. No. 187.

CXXCVIII. WINDING MACHINES.

Machines designed to wind yarn on a cylindrical paper tube are called tube winders, and those winding on conical tubes are called cone winders. These machines are also known as cross winders, and quick-traverse winders.

A large amount of yarn is continually returned to some of our mills, owing to the poor form in which it is put up. In fact, the managers of the

best winding machine companies say that in some cases, even with their very latest machines, it is a difficult matter to suit the manufacturers. Some manufacturers want a soft package, while other manufacturers want a hard one.

Let us consider that the yarn is run on a twister, and shipped away in the form of a spool. To those familiar with the packages turned out by our latest winding machines, the yarn put up in such a form would appear poor. The method of regulating the tension on all old style machines is that of having the ends passing over a traverse rod that is coated with paint, flannel, or other material to create a certain amount of friction on the yarn, so as to lay the coils closer, and thus form a more compact package. To

PROPERLY REGULATE

the tension with such an equipment is difficult. Our latest type of winding machines can be regulated so that the coils can be laid with the proper tension, to either make the package very soft or hard.

It is a well-known fact among mill men that a great amount of yarn is sent to the rope works for no other cause than faulty bobbins, still the yarn on the bobbins may be better than on others that have been accepted by the spooler tenders or weavers. Why do the spooler tenders or weavers reject faulty bobbins? The reason is the same as advanced by manufacturers. They fear that such bobbins will not run out without much breakage, and so they throw them into the waste box. The great advantage gained with our latest winding machines is due to the fact that the compactness of the bobbin can be regulated. An increased yardage in the shuttle means a better quality of cloth with an increased production. The amount of yardage that can be put in a shuttle depends, of course, on the size of the shuttle, and on the number of yarn run.

As the yarn is transformed from the cop or bobbin onto a tube or bobbin, much imperfection in the yarn is discovered, and this reduces the stoppages of the loom.

There is a large amount of yarn wasted in the bleaching, mercerizing and dyeing processes. Much of this can be saved by the use of winders. The packages produced with these machines can be put on a special wire core, and arranged so that not one coil will be disturbed while going through the dyeing process.

With knitting machines where it is convenient to take a number of ends of yarn from a creel, it is

A GREAT ADVANTAGE

to have the supply as great as possible. Some knitting mills use two kinds of spools. Some large cones are used when running long chains, and the small sizes when running short chains.

The diameter of the heads must be increased to hold the necessary length of yarn to run a long chain, and when short chains are run, the heavy spools would cause much unnecessary breakage. By winding the yarn on conical tubes, the lengths of yarn can be greatly increased without causing trouble. Of course, a special creel must be constructed to hold yarn wound on winder cones, but this can be done at a very small expense.

Besides the advantage of making a longer chain, we rid ourselves of the trouble caused by having spools supported by a skewer that revolves in a metal step. In many cases, the spool revolves on the skewer, instead of the skewer revolving in the metal step.

By referring to Figure 66, it can be seen that the yarn is drawn from the cones without the resistance that is generally found with other systems of warping. Trouble caused by the warper creels or tiers getting out of true, and wearing the skewers unevenly, is eliminated. As the yarn is drawn from the cones with exceedingly light resistance, it is possible to run a warper on this system of warping at a greater speed than with the ordinary system.

Little can be said about some warp-

ing departments, simply because the warper creels are kept continually level and in good condition. Still, granting all this, it must be admitted that a certain amount of friction exists, especially when the spools are running low, which makes it impossible to run the warper any faster than the speed quoted above, without causing much breakage of ends, which always results in a poor quality of cloth, with no gain in production. What does this mean to any manufacturer? Stop and think of it. Here, besides running the warper faster, the amount of creeling can be reduced and this means that one warper can do the same work that any two ordinary warpers can do, which also means the reduction of the warping cost. Besides, owing to the same tension existing on all the ends being the same from the start to the finish of the yarn on the cones, the yarn is wound on the beam in better condition for use, which means a less amount of hitch backs at the slashers, which is another defect that is found on most slashers. Our latest winding machines are also fast superseding the

CUSTOM OF TWISTING

from single end spooling, and they are adapted for the doubling and twisting of fine yarns in many mills. The chief advantage of these machines over doubler winders and twisters is that there is no possibility of the yarn drawing below the surface of the package, or splitting the strands apart or falling over the ends. Another advantage is that the yarns run through separate tensions, which can be adjusted to a nicety, so that each strand of yarn is laid under uniform tension on the package, thus insuring perfect delivery to the twister spindle, and besides eliminating corkscrew twists or slack places that are so often found on the ordinary doubler or twister. With the above arrangement, each end controls the stopping mechanism, which is very sensitive, and operates so quickly as to stop the spindle before the loose end runs in, thus enabling the tender to tie single instead of bunch knots.

Modern winders make it possible (1) to wind a considerable length of yarn on a core in such a form that it may be handled in transportation without being damaged and unwound when used without injury to the strand. (2) To wind a number of ends together on one core at an even tension. (3) To prevent corkscrewing or imperfections when twisting.

The principle of our

LATEST WINDING MACHINES

is similar to that of the filling wind on either the mule or ring frame for filling spinning; that is, they are constructed and made to operate. so as to give the ends a rapid reciprocating traverse motion on the core, so that the yarn is first carried from one end of the tube to the other, and then carried back. Of course, on all winders the traverse moves rapidly back and forth and at the same rate of speed in both directions, and the traverse also changes very quickly. Thus, it can be seen that by such means the last layer serves to bind the preceding ones. The coils that form the end of the package are held firmly by the succeeding layers, which makes each end of the package firm. In some winders, the yarn is wound on the core by contact with a revolving drum, while in other types, the yarn is guided along the surface of a paper tube mounted on a revolving spindle. Such a type is shown in Figure 67.

Quick Traverse winders are driven by a driving shaft that passes underneath the middle of the machine, and carries at one end a tight and a loose pulley. Double-grooved band pulleys are placed at intervals along the driving shaft, each of which drives two winding drums. The double-grooved pulleys on the shaft are much larger than the single-grooved pulley on the cone drum. There is one drum on each side of the machine, and the band passes partly around the double-grooved pulley, then around the small grooved pulley on the drum, back again to the double-grooved pulley;

from there to the small grooved pulley on the other drum, and back again to the first double-grooved pulley.

SPINDLE WINDERS

Spindle winders accomplish the same purpose as the quick-traverse winders, the chief difference being that a spindle is used, instead of a drum. One spindle constitutes one head, and a common construction is to have several heads side by side, as shown in Figure 67. Referring to Figure 67, it can be seen that the cop is placed on a spindle, and the end passed upwards through a guide wire. From the guide wire, the yarn passes around the tension finger, then through a slot in the plate, then over a pin, and at an angle to the next guide wire, through the traverse guide eye to the core or package.

Like all guide wires, the centre of the loop of the guide wire should be directly over the point of the spindle in the yarn holder. The tension on the yarn is regulated by changing the weights which are hung on a special system of levers.

These machines are equipped with what is known as a kink or snarl arrester. It is simply a flat plate with a long, narrow slot through which the yarn passes, and serves for the same purpose as the kink or snarl arrester used with the ring spinning frame.

As a rule, spindle winding machines are operated in groups of six heads, and this combination is spoken of as a gang of spindles. There are few hard and fast rules that can be given for operating a winding room. The chief aim of mills selling yarn should be to suit the buyer. There is no department in a mill where the numbers of yarn are more liable to get mixed than in the winding room. The chief cause of the yarn getting mixed in many rooms is not marking the yarn until it reaches the winding room. The only way to prevent the possibility of the yarn getting mixed is to mark it as soon as it leaves each department. If the yarn comes from another firm, it should be marked immediately upon its arrival. No. 188.

CXXCIX. WINDING.

Buyers in some cases will demand that the cone or traverse be of a certain length, but when not specified by the buyer, a 5½-inch traverse is generally used. Buyers will also insist upon a certain diameter, and this has often caused trouble. When an order is received by a mill for ones of a certain diameter, it should be realized that the buyer makes such a specific demand for necessary reasons. Many overseers in charge of winding rooms do not appreciate the importance of supplying yarn packages of the exact size ordered.

The overseer in charge should instruct every winder to remove the cones or bobbins when they attain the size specified, and he should watch this point continually. Parallel tubes, as a rule, are made with 5½-inch traverse and 4½ inches in diameter. The dimensions given above are found generally in use for ordinary cotton yarns. Winders are also adapted for use with braid and tape looms, where the machine is attached to the end of the loom. The quill winding is done by the weaver. Stop motions and supply holders for two and three ends are supplied for use in winding on bobbins for braiding machines, the winding being done directly on the braider bobbins or on tubes as may be required. In most cases it is more economical to wind each package of yarn on a separate spindle. The loss of time in doffing more than

OFFSETS THE INCREASE

in the spindle capacity where two or more are wound on the same spindle. However, in case of mercerized yarn and bleached thread, which are sometimes marked in packages of small dimensions, the strands are wound in multiple form, as the traverse is short and the diameter small.

For taking train silk and fine yarn from spools, a compensating unroller is used which automatically controls

the rotation of the spool and regulates the tension. This also controls the delivery of the thread to the winding spindle, insuring uniformity of tension at all times.

When cotton or silk yarn must be wound on cop tubes, a slight change must be made in the adjustment of the machine from that of bobbin winding. One point to be noted in studying modern winding machines is the carefully designed system of automatic lubrication. The body of some of these machines is a lint proof oil reservoir that holds enough oil for many months.

The overseer of winding should see that the oiling is carefully performed, because, although this automatic system avoids the necessity of giving constant attention to the quick revolving parts, there are other parts that do not revolve so quickly, and should be oiled about twice a week. In oiling these parts care should be taken, because in case of an excess of oil, the yarn is liable to become stained.

Due to carelessness the yarn sometimes runs over the end of a package, even when good machinery is used. There is little excuse for this, for with proper care modern winders give satisfactory results.

WRITER VISITS MILLS.

The writer some time ago visited a small mill where much trouble was experienced with the latest winders, the man in charge blamed the construction of the machines, and claimed that it was with much difficulty that he could keep the machines running. He even claimed that he could not keep the belts on. The writer examined a few machines closely. Many parts of the machines were working loose and the equipment was in bad condition. The machinery had simply been abused. Manufacturers should not take advice from men who do not give their machinery proper care. After visiting the mill mentioned, the writer went out to New Bedford, Mass., and had occasion to visit the winding room of the Kilburn Mills. Here 302 winding machines were found in operation, winding all kinds of cotton yarns. Every package from these machines were perfectly wound. It is safe to say that no winding room could be found in a better condition than that of the Kilburn Mills.

The writer at one time took charge of a fly frame room equipped with the largest type of fly frames, and almost every bobbin wound consisted of overrun ends. The former overseer claimed that the cause was due to the bolster not being rigid enough. He claimed that it would move angularly and raise the spindle. Then, when the rail would change its direction, the bolster would allow the spindle to drop to its proper position. This poor work had been going on for weeks, and the whole trouble was due to dry spindle bottoms.

Dry spindle steps will cause overrunning of the ends on the bobbins, and the fact was clearly proven in the case just mentioned. As soon as the spindle steps were oiled, overrunning of the bobbins ceased immediately. Neglect will reduce the efficiency of any machine.

WINDERS.

Winders are simple machines and easy to operate, and if not neglected no serious trouble will be experienced. It is for the reason of their simplicity that they are often neglected. Some men in charge of these machines expect them to run forever without any care.

The chief trouble found with winders is caused by not having the best relation between the speed of the traverse and the length of yarn wound. This is a trouble that is well understood by any person having had experience with winders. Smooth yarn or ply yarn require a quicker traverse in proportion to the amount wound than any other common single yarn, and for this reason, it requires a little study to obtain the best relation between the speed of the traverse and the length of the yarn wound.

When more than one end is wound

on a tube, the stop motion must be set to a nicety so as to make it as sensitive as possible. The yarn runs through separate tensions which are adjustable, so that each strand of yarn is laid under uniform tension on the package. If the stop-motion is properly set it should operate quickly enough to stop the spindle before the loose end runs in. This enables the operative to tie a single instead of a bunch knot. The overseer in charge of a winding room should instruct the operatives so that when an end breaks they will carefully tie as small a knot as possible.

Unsatisfactory winding is often caused by not having the friction cone fit the conical shell. This affects the spindle in two ways. The drive is not positive, and the spindle is not checked properly. Winders should be examined often to see that the driving pulley revolves freely when the friction cone is out. When the friction cone is out the driving pulley should have no tendency to impart motion to any other part of the winder.

The production of winders is affected by the counts and quality of yarn and also the number of ends run. For ordinary purposes a quick traverse winder will wind about 150 yards per minute, and something like 20 per cent should be allowed for stoppage. Another point that is overlooked in many winding rooms, and one that causes much ravelling off, is not tieing the end of the yarn last wound. With both parallel tubes and cones, the end of

YARN LAST WOUND

should always be tied, because it takes but slight ravelling off to give the package a bad appearance, and this combined with careless packing is often the cause of cancelled orders. Many cotton mills pack their cloth in smooth paper and afterwards pack these packages in wooden cases. Although many mill men may see no advantage in such a system, nevertheless, you will find the mills that have put this practice in vogue never curtail and they are continually enlarging their plant. No. 189.

CXC. THE MANUFACTURER.

The manufacturer should consider the advantages derived by the use of winders. He should not be influenced against these machines by men who give little or no study to this operation. The increase of the shuttle capacity of looms alone should be of interest to the manufacturers. Probably no inventive contribution has been offered to the cotton trade which is more important than the mule. Samuel Crompton, of Bolton, completed, in 1775, his invention of the "mule jenny", in contriving which he had been engaged for years. Although the mule from the start was recognized as a machine of merit and advantage, it did not come into general use, nor was its value really known to the cotton or any other trade until after the expiration of Arkwright's patent, the spinner until then being confined to the roving.

THE JENNY.

Prepared for common jenny spinning, however, about the year 1779 Crompton combined the principles of the jenny with those of the water frame, which had been previously invented by James Hargreaves, and was of the intermittent spinning type. After the spinner was allowed to make use of Arkwright's fine process of preparation, or in other words, after these two widely different machines were combined together, the name mule was applied. It is admitted to this day that the mule can spin wider range of counts than any other spinning machine.

One thing is certain, and that is, that its introduction formed an important era in history of the cotton manufacture. Although the operation of mule spinning differs much from that of ring spinning, the principle of each process is the same, that is, the final attenuation is imparted in spinning, and in addition, a certain number of turns to the inch is permanently inserted to give to the yarn

the strength necessary for the purpose for which it is intended.

In the management of a mule room, it is in this respect, especially, that the man at the helm can distinguish himself. There is no department throughout the mill where there is so much argument between the operatives or spinners and the overseer. A good mule spinner is worth his weight in gold to a mill, because he can either increase or decrease the amount of waste made in the weave room to a large extent. To handle a mule well requires experience and judgment, and one must also be a good judge of the roving received from the carding department. There is

NOTHING SO DETRIMENTAL

to the operation of mule spinning than uneven roving. It must be understood here that there are a great number of overseers of mule spinning who watch every box, but they do not know enough about it to determine the faulty construction of the roving. This examination and feeling of the roving becomes to them a habit and little is gained by it. We wish to give a good point here, and one that is misunderstood by most mill men, even by practical mill men, and which is the cause of many heated arguments between the carder and mule spinners. When an overseer of either the ring or mule room examines the roving in order to determine whether there are enough turns to the inch or the necessary number lacking, he pulls off a certain amount of roving from the bobbin, at the same time holding the roving in one hand. When this is done, the

ROVING IS UNWOUND

from the bobbin by circling the hand around the top of the bobbin, and this is where a great mistake is made, because, when the above method is used to pull the roving from the bobbin, it gives the portion pulled off a very bad appearance, and to the naked eye, it looks very uneven, giving the same appearance as cut roving.

There are, no doubt, many carders who will read this article who have been up against the above proposition, and, perhaps, came out second best. However, the writer will give a remedy that will, no doubt, help out the situation for the reader if the above should confront him in the future. The proper way to examine a strand of roving is to take hold of the end with the forefinger and thumb, and instead of turning the hand around the top of the bobbin, just pull the hand away slowly from the bobbin and turn the bobbin so as to follow the movement of the hand. When this is done a few times the difference in the appearance of the roving will be easily noticed. When the method given above is employed, it will be found that the roving will have a smooth, even and flat appearance, that is, if the construction of the roving is as it should be.

When the first method is employed, no matter how even or perfect the roving is, it will have a very uneven and

CUT APPEARANCE.

Of course, what causes the roving to have such a bad appearance when pulled off in the manner explained above is understood by a great many practical men, but there are a great number, however, to this day that could not explain this.

Now what causes the roving to have such an uneven appearance when unwound from the bobbin without turning the bobbin? There are, of course, various answers to the above question, but the chief answer that fits the case is that it is the compactness of the bobbin which gives the roving this appearance. In order to clearly understand the writer, let the reader examine a slubber bobbin when the last layer is running out in the intermediate and he will notice that the strand is much flattened, which is, of course, due to the compactness of the bobbin. No. 190.

CXCI. PRACTICAL TESTS.

Now to get a clear understanding

of the point the writer wishes to convey, let the reader break out the slubber bobbins where only one layer of roving is left on the bobbin, and then pull off a certain portion of roving in both methods described above, and the reader will quickly agree with the writer that the above has

CAUSED MUCH TROUBLE.

It will be found, if the above is tried, that the coils nearest the bobbin will have a very flattened appearance when the bobbin is made to rotate, and the hand holding the end is pulled slowly away from the bobbin, while, on the other hand, if the roving is pulled from the top of the bobbin, these uneven places will show up a great deal more to the naked eye. In this way the above will be clearly understood, because from the experiment it will be discovered that these uneven places that show up so to the naked eye are not uneven places but, instead, merely the change in the position of the strand. As stated, when the experiment is tried with a slubber bobbin, the false appearance that the change of position of the strand gives to the end will be more readily seen.

Another method that will prove that the roving shows uneven places when pulled from the top of the bobbin is by twisting the portion hard that shows very defective, and then wet the forefinger and thumb, and this will quickly prove that it is the change in the position of the strand that causes these defective appearances; that is, as stated, if the strand is properly constructed. Many carders have

LOST THEIR POSITIONS

because they did not understand the above point, and, no doubt, there are many readers who could point out where this occurred perhaps in the very mill in which they are now working.

The reason why the writer of Studies in Mill Management lays so much stress upon this point is because in his mill life, this trouble has occurred frequently. The writer remembers well, when he had charge of a ring spinning room in the state of Maine that he experienced much trouble with a new carder, for the reason that his roving was cut, but claimed

TO DEFEND HIMSELF

that it was in the strand changing position when unwound from the bobbin. But when the writer twisted the defective portion of the strand pulled from the bobbin, after which he wet his forefinger and thumb and passed them over the roving, the cut places in the strand could easily be seen.

The writer also knows of a place where a carder enjoyed a good position for almost a score of years, but was forced to resign, simply because he could not defend himself, and really thought the roving was cut, and his admission of this to the new spinner cost him his position. An overseer of the mule room in many mills can be said to be between two fires continually, because if the yarn or cops are not properly constructed, complaints come from the weave room. On the other hand, if the yarn becomes too light, which is caused by

LIGHT ROVING,

this reduces the spinners' pay, and, of course they find fault. When roving gets on the light side, it of course, lacks the necessary number of turns to the inch, and a lot of breaking back is the result. Now, there is nothing more aggravating to a spinner than the roving breaking back, because in many cases, when it does break back the spinner is obliged to go around in the back alley to place the end in the rolls again. This, combined with the light work in front which decreases the spinners pay, causes trouble in many mills. It is with pleasure that it must be said that strikes seldom happen now. There are, however, a certain class of overseers who get by quite easily by keeping the filling continually on the heavy side. This, of course, just suits the spinners, because this to them means more pay, and besides the

work will, of course, run better, which means less work.

When a piece of cloth is figured, the most common method used concludes by subtracting the warp yarn from

THE AVERAGE YARN

found, and then if the cloth is found heavy the filling is made lighter. But there are many ring spinners who do not understand the above point, and they let the mule spinners take advantage of this. There are all kinds of tricks in cotton manufacture among the overseers, and one that is worked to the limit, is reducing the size of the sizing reel, especially if the mule spinner has the use of the reel for his own sizing only. It takes a very clever man to discover when a reel has been reduced, and although the writer is willing to admit that the reduction of an inch in circumference does not show up much in the number of the yarn, still by getting the best of the ring spinner and using the reel besides, it can be seen that he enjoys a great advantage. The above is often reversed by the ring spinner who will make false reports of the weight of the beams, as was explained. The point should easily be seen by the reader. In many mills the average weight of the yarn is found from the weight of the beams and not from the sizeing.

The reason given for employing this method is that, it is claimed owing to the yarn being stretched it is lighter when it reaches the beam, and, therefore, lighter than when leaving the ring frame. So some ring spinners will reduce the draft on the frame and

MAKE FALSE REPORTS

of the beams, that is if a beam shows heavy, the man who does that weighing is so trained by the ring spinner that the slate shows the number of the yarn on the beams consisting of a long draft on the frames. The above is one good reason why it is not always advisable to give the spooling, slashing, and warping in charge of the ring spinner. However, if the above practice is carried on, it forces the mule spinner to lighten out on the filling. Some ring spinners do not stop here, but will get another tooth and if this is not discovered by the superintendent, the mule spinner is again forced to lighten out another tooth. The above need not be doubted, because the writer knows of a case where the ring spinner falsified the beam reports which resulted in forcing the mule spinner to make a filling lighter than 45s instead of 42s, which should have been spun.

When the weight of the beams is falsified, it places the mule spinner in a bad position, because he is, of course, unable to defend himself in regard to heavy cloth, having no knowledge of the weight of the beams being falsified. The weaver comes in for a share of the trouble also, because the superintendent, being as

MUCH AT SEA

as either mule spinner or weaver, imagines that the mule spinner is reporting his yarn much lighter than it really is, that the weaver has miscalculated the number of ends in the warps, or has not enough paper on the sand rolls, etc. However, the spinner must lighten out to remedy the weight of the cloth, and as stated, this reduces the spinner's wages, unless, of course, the price per pound is changed correspondingly.

Very few understand how some superintendents will prefer to fight the spinners instead of fighting the office, and for this reason, will not allow the overseer to make a correct report of the number of filling being spun. This is understood by most mill men, because if the weight of the yarn is correctly reported, an investigation is demanded from the office, a task that falls upon the superintendent, and one that the superintendent dreads, on account of being already at sea. Spinners can judge almost the exact size of the yarn by the feel and handle of the yarn in the spinning

operation, and of course, as soon as it is discovered that the yarn is coming in lighter a committee of two or three is appointed to interview the overseer, and then if no satisfaction is received, the next step is to interview the superintendent, and if

NO AGREEMENT.

is received from this course the union is called in to settle the matter which in some cases results in a strike.

Now the reader must not forget that we are studying mill management, and although the above trouble seldom happens, it does happen at times, and the spinners are put down as fussy fellows when the trouble is really through a dishonest ring spinner. The writer is willing to admit that very few ring spinners stoop to such low tactics; in fact the writer has had twenty-five years' practical experience in different cotton mills, and knows of only two such cases to have happened. However, when such cases do happen, it is difficult to locate the trouble, because some ring spinners will have only about one-half the frame with a short draft, and those will be found in the centre of the room. This is done so that if the superintendent figures the proper draft of the frame, he will, of course, know what draft gear should be on the ring frame, and when he goes to the spinning room to ascertain the right gear, he will

IN MOST CASES,

of course, examine the gear on the frames nearest the door or walls, and the trouble is not discovered.

Again, it should be observed that even if the yarn was sized it would seem to be right, and for this reason it pays a superintendent to take what is known as a pick up in both the ring spinning and mule room every little while. He should also weigh an empty beam say, once a week, to ascertain whether the number marked on the end of the empty beam corresponds with the actual weight of the empty beam.

Another good point to preclude such trouble is to allow the overseer of mule spinning to weigh the beams himself also when he so desires. Surely the ring spinner should not object if everything is straight, but if he does object, nine cases out of ten you will find that it is a confession on his part that the weight of the beams are falsified on the slate. A few mill men may doubt that the above has ever happened in mills, but the writer has known ring spinners to have a difference of four teeth about the room. No. 191.

CXCII. CAREFUL OVERSIGHT.

It can be seen that a shorter draft on the frames in the centre of the room is going to take in the roving quicker, which, of course, means an increase in production. While on the other hand, in paying the same price for spooling and warping this heavy yarn, the operatives under his charge make better wages which gives him the pick of the help among the neighboring mills. The above tactics can be discovered often, by taking a portion of cloth and holding it up to the window, and here will be seen a certain number of threads having a thicker appearance than the adjoining ones.

The reader must not misunderstand the writer, and get the idea that if a piece of cloth is examined and some coarse threads found in the cloth that the ring spinner where the yarn is spun is dishonest and carrying on such a a practice as referred to above, because there is not a cloth woven that will show every thread, either warp or filling. But when the ring frames about the room have a different draft, say, one-half the frames, then the number of coarse threads will show correspondingly in the cloth, and the above can be traced as the trouble in nine cases out of ten.

From what has been said above, let us consider that the mule spinner and also the weaver have the privilege of

WEIGHING THE BEAMS

when they desire to do so. Would not this be good mill management? Surely, in this way, all hands would know what to do in case the cloth varied,

and the doubt that often exists in the mind of the mule spinner when told to lighten out would not exist, or in other words, he would be more satisfied that conditions demanded a change. But instead of the above system, in many of our mills, the mule spinner is supposed to have no business with the ring spinner, and so, in this way, it gives the ring spinner having charge of spooling and warping every advantage if he has a mind to be dishonest.

The ring spinner and weaver should be allowed to size the filling, and with such a system it can be seen that every man in charge of each department would know just what to do to keep the weight of the cloth right, or in other words, by sizing the yarn together, the sizing found would, of course, indicate what man should do the changing when the cloth is not standard. It is also a good plan for a mule spinner to take a few rovings from each box of roving that comes from the card room and have them

PUT IN AT THE END

of the different mules. It must be understood, of course, that the overseer is not supposed to do this himself, but he could instead so train his hoister that a few rovings from each box could be placed in a certain spot and afterward put in the different mules by the second hand.

The above system is of the utmost importance in the management of a mule room for various reasons. 1. If the yarn sized from the bobbins taken from the boxes shows up very uneven, the overseer can at once warn the carder before a great amount of uneven roving gets into the creels. The above is a mistake that is often made by many overseers of mule spinning, occurring more often in mills where double roving is run than with single roving. The reason for this is that when the roving is uneven in the mules running single, trouble is noticed at once by the spinners, who acquaint the overseer of the fact. The carder's attention is called and the trouble is somewhat remedied before a great amount of roving gets into the creels.

On the other hand, if the overseer of

MULE SPINNING

is a careless fellow, and neglects watching or sizing the roving coming from the card room, and at the same time running double roving, the unevenness in the roving is not discovered as quickly by the spinners, and the consequences are that a great amount of roving gets into the creels before the carder's attention is called to it. The above should be easily reasoned out by any person who has had even a little practical experience, because when a mule is on single roving, one roving will last three days, and the same roving when running two into one will last six days, providing, of course, that the same number of yarn is run in both systems.

By a little neglect on either the part of the overseer of mule spinning or carder, uneven work remains in the creels in some cases for weeks when the work is fine. 2. The amount of twist in the roving can be discovered from these pick-ups.

For instance, let us assume that the stock coming through the card room is more wiry than the stock already in process in the mule room, and that this stock has escaped the carder's notice. It can be seen that when the roving is put in the mules by the second hand in the manner described above, such roving will make the sizing from these

BOBBINS HEAVIER,

and although the yarn will show the same as in the first case, here is where the mule spinner must be careful; that is, instead of demanding the carder to make the work lighter, he should ask him to take a little twist out of the roving. Here is where many overseers of mule spinning make a mistake, and by so doing come out second best.

Assuming that the work is made heavy from wiry cotton and the mule spinner demands that the carder lighten a tooth, what is the result? This, of course, for the time being will give the right

number of yarn, but think what a mess is made when fluffy cotton follows the wiry cotton. Now, some may think that taking the twist out is of no more advantage than lightening out, but let us reason this out together. There is the difference that if the work in the card room is made heavy from neglect on the part of the carder to

WATCH HIS WEIGHTS,

then, of course, he should lighten out. But on the other hand, if the work is made heavy from a change in the stock, the twist by all means should be changed in the card room, because when this change is made there, as soon as this wiry cotton runs out and is followed by fluffy cotton, it will be discovered before it reaches either the ring or mule room. While, on the other hand, if the changing is done by changing the hank roving, the fluffy cotton coming in is not so liable to be noticed, owing, of course, to the amount of twist not being changed in the roving, and thus the light work finds its way to the spinning room, and for this reason, a pick-up sizing should be put in every morning.

There are many overseers of mule spinning who stand in their own light by not having the twist taken out of the roving when conditions demand it. Some men seem to figure on cleaning the carder out of roving. They do not stop and think how hard twisted roving injures the top rolls as well as the work. The writer has seen the roving twisted so hard that it caused the front roll to stop, the strand being, of course, stronger than the frictional contact between the bottom steel and leather top rolls and the strand delivered so strong as to bend the mule spindle slightly, besides injuring the top roll to such an extent as to require recovering. No. 192.

CXCIII. THE MULE ROOM.

In the mule room, as in any other department, the main object is a large production with due regard to quality. The quality of the production is more or less governed by the roving received from the card room. There are many ways, however, in which poor yarn can be made without any such excuse. The breakage of ends on the mule is a good criterion of the conditions in the mule room. Ends do not break in the winding without good reason, and there is not a practical man but will admit that with a fair

QUALITY OF ROVING

there are plenty of chances for defects on the way to the spindle.

The rolls may not be in good condition or not properly spaced. A careful overseer will see that these conditions do not exist. A mule should not be allowed to run more than four weeks without taking out all the top rolls (one-half each week), and give them a good cleaning. The stands should be well cleaned and greased and all the laps and dirt cleaned off the bottom steel rolls, and from the top rolls as well. Top rolls require careful attention. Using a worn-out front roll as a back or middle roll is a mistake, and one that is too often made in many of our mule rooms. The middle roll should be in as good condition as the front, in fact, from a practical point of view, the middle roll should be in the best of condition, and why? Because the function of the middle roll is to grip and hold the fibres while passing under its action. So, if a slightly worn front roll is put in the middle row, and a new one in the front, to the naked eye it may seem an improvement, because a new roll does look good, but what actually takes place after the change is what should be considered.

Watch the yarn as it leaves

THE DRAWING ROLLS

after making such a change, and in every case, light and thick places will be noticed. What causes this? The cause is due to a poor roll, which is not in close enough contact with the bottom steel roll at every point on the surface as it revolves. This, of course, allows the fibres to escape in clusters, because the surface speed of the front roll is much greater than that of the second roll, and this creates a continued tendency of the front roll pulling away all fibres that are not

gripped by the second roll, and this, of course, causes light and thick places throughout the length of the yarn.

The finest of yarns are spun on a mule, as a rule, and with the above in mind, the reader should see the importance of keeping the middle roll in the best of condition. Of course, it must be understood that a poor front roll is also bad, and will make defective yarn, but not as bad as with a poor middle roll. This should easily be seen. For instance, let us suppose that we have a poor front roll and a very good middle roll. In such a case, the end may often lap the roll, or the front roll may not have as firm a grip upon all the fibres passing from under the action of

THE MIDDLE ROLL,

and for this reason, may not act on a few fibres the moment that it should, but even at that, it should be seen that with a good middle roll, there is no danger of the front roll pulling the fibres away in clusters from under the action of the second roll.

For the above reason, a fluted roll will make coarser yarn from the same roving. This is due to the corrugations on the roll passing more fibres through in the same length of time. A good overseer of mule spinning watches not only the condition of the surface of the top roll, but the inside also. Such an overseer demands from the roll coverer that the cloth be of sufficient thickness to form a good cushion, because there is more poor spinning made by damaged top rolls than in any other manner. For this reason, the greatest of care should be taken in adjusting saddles, levers and weights so there will be no loss of leverage. Top roll ends should project slightly above the cap bars, so that fly and dirt can be removed without the use of a picker. It is impossible to keep ends of rolls clean when they are sunk down in the cap bars.

ANOTHER IMPORTANT MATTER

in mule spinning is to have the under clearers as far back as possible, but not so as to touch the stirrup. Another important matter is to have the roving girdles set properly, because if not set in the proper place when the traverse motion is working back and forth, it will cause a few ends to escape from the end of the roll, which results in roller laps and broken ends, a feature that is much detested by the mule spinners. How many of the latter in charge of mule rooms at the present time are able to sample a portion of cotton and get the proper length of the staple to enable them to space their rolls properly to suit the length of staple found? Of course, the number that are able to do this is great, but on the other hand, is it not a fact that the carder's word is taken for it?

This subject is an important consideration, because when one stops to think of it, to set a top roll to suit the

LENGTH OF THE STAPLE

passing under its action is a difficult thing to do. In the first place, every person that has any knowledge of cotton knows that it takes much experience to become a good judge of the staple regarding its length and whether it will take twist or not. In the second place, it must be admitted that none of us can any more work alike than we can think alike, and for this reason, you will find two men who will pull a staple precisely the same. In the third place, you will find that in most cotton mills especially in fine mills where a great amount of changing is done, these men in charge of setting the rolls become careless after a time, and will, in the majority of cases, leave a top roll out of alignment. Now, when the finest of yarn is spun on a mule, none of the above evils can exist and make perfect yarn at the same time. A good mule spinner means much to the success of a plant, because in order to get a good, even, strong yarn it is necessary to have the space between the rolls slightly exceed the length of the staple in use. Some will give a rule by telling us that the space between the rolls should exceed the average length of the staple one-sixteenth of an inch. This setting is stated in different textbooks, but this is given more to check some who may go to extremes.

For instance, if the majority of students were told to set the rolls up to almost the length of the staple, it is safe to say that such would be

A MISTAKE,

as many could use such an advocated setting for an argument and the result would be that the quality of yarn turned out would not be as good as the present. However, we must admit that the mill that is fortunate enough to have an overseer of mule spinning who has that judgment of keeping his rolls set up almost to the length of the staple, is the mill as a rule that loses very little in times of depression.

There is a certain law that governs the art of drafting, which is that, in order to obtain a gradual draft at all times between the rolls, which is necessary to make an even thread, the closer the rolls are spaced to the length of the staple, and at the same time exceeding the length of the latter, the stronger and evener the thread will be made.

Another cause for broken yarn is bad or uneven winding. This always

CAUSES TROUBLE,

and makes it difficult for a spinner to operate it properly. There are, of course, a number of causes for this. For instance, sometimes the backing of friction will cause it by not freeing itself as it should do when the fallers lock. This is caused sometimes by an old and worn-out friction, or a wrong setting. If the winding click catch is not taking hold as it should, or the backing off click catch is missing a tooth or two at times, thus throwing off more yarn some stretches than others, this causes uneven winding. If the leather in the click is not in good condition, it is impossible to make them take hold regularly. For this reason, new leather should be put in occasionally as the case requires.

No. 193.

CXCIV. AVOIDING DEFECTS.

If the bowl which runs on the copping rail becomes worn, it should be taken off and trued. On mules that have run a number of years, the writer has seen the carriage slides on the shaper side of the head worn down in places so that it was almost impossible to get a good even wind, because the carriage was running lower at times than it ought to, thus causing the copping faller to dwell too long in one place and traverse too quickly in other places. This causes not only bad winding, but sometimes a bad looking chase. The only remedy for this is to take the carriage slide out, and have it planed off level.

IMPROPER WINDING

may be caused in the cop bottom by the traverse of the quadrant nut not being properly performed. This is a point which should have careful attention. The quadrant traverse is a matter to which some care should be given, as it is impossible to give a rule to guide the operator. The quadrant arm should be set behind the vertical line at the commencement of winding, and a common practice is to set the quadrant vertically when the bowl is on the highest point of the copping rail and the full diameter of the cop has been reached, but it must be understood here that such an adjustment does not answer in all cases. The best practice is to leave the setting to careful observation.

The delivery of the chain to the carriage by the quadrant during its inward movement cannot be other than variable, and the amount of variation depends on the circumstances of the case. For instance, if the quadrant is too high, it will give slack yarn. On the other hand, if it is too low, the yarn will be too tight, and consequently, in the first case, there will be kinky yarn, and in the second case ends continually breaking would be the result.

The proper building of the cop depends on

TWO OPERATIONS,

namely, the traverse of the faller and the proper rotation of the spindle. These two factors have a close connection, and each depends on the other. It is obvious that improper setting of

either of the two would entirely destroy the relation of one to the other. It is this which renders this part of the operation of a mule of great importance.

We will now consider some of the defects usually found in cops, and the causes which produce them. A uniform length of yarn is wound on the spindle during every run in of the carriage. If the traverse of the winding faller is not correct, or if the speed of the spindle is not regulated properly, then some of the yarn will be wound on a part of the cop where it should not be, which, of course, results in a poorly built cop, and if care is not taken in readjusting, it will lead to trouble some where else.

Cops are often badly shaped instead of maintaining a uniform shape in the body of the cop, and they also vary in thickness at different places. In other cases, the nose of the cop will be spongy and soft, so that when the yarn is being unwound it unravels and causes a great amount of waste. Sometimes cops will also

VARY IN LENGTH

and thickness when they are spun on the same mule. All these defects can be remedied by ascertaining the part of the cop in which the defects exist, and by so doing, a guide is given to the parts which need adjusting or altering.

If a cop becomes thicker in one part of the body than it should be, this enables the experienced observer to determine the place where the defect originated. It would be evident that, for some reason or other, the gradual elevation of the faller during winding was not taking place at the proper time. On the other hand, if the cop becomes thinner as the cop builds up, then it could easily be seen that the elevation of the faller was taking place too rapidly, and instead of the cone being properly formed, the first coil of each stretch was being laid upon a portion of the cop where the diameter was too small.

By exercising a little thought and judgment, much time and labor will be saved.

THE COPPING PLATES

are formed with curved portions at their upper ends. When the copping rail is in position to start a set of cops, the studs on each end of the copping rail rest on the curved parts of the plate, and the result of the inward traverse of the copping plates alters the position of the copping rail too rapidly. The curve on the back part of the copping plates is much steeper than on the front, and the result is that the back part of the copping rail falls more quickly than the front and the traverse of the fallers is rapidly lengthened. This action is intended to form the bottom properly, and it is to this fact that the proper setting of the plates will enable a longer or shorter cone to be formed.

This can be done in more ways than one. For instance, if the back plate is moved forward, the stud will rest on a higher part of the curve and the back part of the copping rail will fall more quickly as the plate is pushed back. It should be clear to any practical man that the cop bottom can be lengthened or shortened at will by the adjustment of the parts in such a manner that when the inward motion of the plates takes place, the back copping rail will fall more rapidly forward than the front. Care should be taken, however, that the

POSITION OF THE RAIL

is not so as to allow the yarn to be wound below the lower coils on the bottom cone. If this is so, the yarn is liable to be broken when being unwound in the shuttle.

Another important point in copping is to have two spirals of yarn wound close to the nose of the cop. This can be done by having the rest on the boot leg of proper shape or angle. The object of doing this is because when the mule is backing off, if the backing-off chain is properly adjusted, at least one of these spirals will be dragged down and locked on the top of the nose, thus causing a good nose to be made all through the cop. It is

advisable to give warning against undue interference with the copping plates and rail, because unless the alterations are skilfully made, evils worse than those it is intended to cure will be produced. No. 194.

CXCV. MULE ALIGNMENT.

We will now give some attention to the alignment of the mule. When aligning a mule, the first thing to do is to let off all the bands and then remove the top rolls and bottom steel rolls. Uncouple the roller beam at the mule head, then level the head both ways. Level the mule ends the same way and then run a line from one end of the mule to the other through the front stand. Level the line in the centre of the stands, then place a small block in each end stand to hold the line slightly up so that the line will just slightly clear the highest stand. After getting the head level and straight, go over the roller beam with a spirit level and lower or raise the sampson, as the case demands Also move the stands in or out so the line will show exactly in the centre of every stand.

In some cases, it is impossible to move the stand. In such a case, take out the lag screws and move the sampsons as required, replacing them after the beam has been set right. Next. level up the tracks. If it is necessary to level the tracks from one to another, to get a long enough

STRAIGHT EDGE

to reach from the roller beam to the track at the head end, set all the tracks by this stick from the beam, then level the track and leave the beam end where it has been put, and this will make all the parts level, so that they will work in unison. Next level the carriage by first loosening the cylinders, and at the same time see that all couplings and bolts are tight. Place a small spirit level crosswise on the bottom of the carriage, and then raise or lower the carriage as condition demands at the spiders until it is level.

Go over a second time, as sometimes lowering or raising one point will alter the next one just left or right. Make a gauge to fit between the top and bottom of the spindle rail and set them all even. The object in doing this is that if the spindle rail is higher in one place than in another when the tube is put on the spindle after doffing and set with a tube setter, the tube will be higher where the rail is highest. The result is that the threads are

NOT EVENLY WOUND

on all the tubes, the threads being wound too low where the top rail is highest.

Next run a line in front of the carriage. Get two pieces of board, bore a hole in one end and cut a slot in the other, bolt to the ends where the faller stands belong, and place your line in the slot, then tighten your line and measure from it to the carriage, and if not found straight, make use of your diagonal rods, but be sure and leave all your rods taut.

Next take a long, straight edge and measure from your front roll to the spindle at the head, then measure same at the ends, and if the carriage does not measure the same at the ends, loosen all the bolts in the square connecting the carriage, and draw in or out as required, using your tie rods connecting your carriage with square until it is in line from end to end, then lighten up your square. Next get three long boards and bolt them to the sampsons, and fix the other end to the back of the carriage perfectly steady, at the same time making sure your carriage is perfectly in line. Then loosen all your fallers at the top spindle rail. The reason for this is to allow your top spindle rail to move freely in or out when

SETTING YOUR SPINDLES.

Now you are ready to set your spindles. Take off your brackets where your squaring bands belong, then take boards and bore a hole in one end and a slot in the other, bolt them to the carriage ends and run a line from one end to the other. Now take your spindle gauge and level your spindles ac-

cording to requirements, putting them in line at the same time. Do not attempt to get them right the first time, but instead go over them two or three times. Next, tighten all your bands and loosen your back stops, and put your carriage up to the beam. Take your spindles and roller gauge and get the height of the spindles from your steel rolls, and set the spindles below the delivering point of the rolls. About 2½ inches below the delivering point for medium numbers, and for fine numbers 2¾ inches is considered about right. Next set your stops and run your mule out and line your cylinders and fallers, but be sure and never line your cylinders and fallers before topping your spindles.

After lining and leveling your fallers, see that your faller shaft is resting on all the bearings. This is very important, because after mules have been running a number of years

THE FALLER STANDS

are worn, and when you are lifting one up it will lift the next one, so that when you put your gauge on it shows all right, but still it is not touching the bottom. See that all your faller sickles are of one shape. This can be done by making a gauge to fit on the faller shaft and the faller wire, bending the sickles in or out as required. Now your wires must be set. The proper way to do this is to have gauge made to fit on the points of the spindles and reaching down to the faller wire after setting your changes; your mule is then ready to start.

The quadrant plays an important part in the operation of mule spinning, and most cop troubles, as a rule, can be traced back to this part of the machine. Let us assume for the convenience of illustration, that a mule is making a cop with a short chase on the tube, and it becomes longer as the set of cops are filled. Again, let us suppose that it is intended to make the chase longer without making it become too long when the cop is full. The best way to do this is by letting what is known as

THE BACK SHOE

back towards the rear of the mule slightly, and at the same time letting the long rail down slightly. In making this change, it is necessary to lengthen the boot leg slightly, so as to make the yarn wind as low on the tubes as before the change. It must be understood, however, that this will not change the shape of the cops.

In case of cops having a round bottom, which in most cases is short, you will find that the coning parts of the shoes are worn flat, or may have been filed by a person in charge of the fixing who did not understand his business. In order to remedy this, when filing leave the highest part at the back towards the coning part, and take more off as you get down toward the point where the shoulder is turned. In doing this it requires the best of judgment, and the greatest care must be taken not to take off too much. Instead be careful and make the bottom become longer and straight without making other changes.

When cops show

A HOLLOW BOTTOM

this indicates that the coning parts of the shoes are too high at the beginning and ending of the set. When cops are larger at the shoulder and finish, this indicates that the shoes have a low place between the coning and finishing parts. The cause should easily be seen, because shoes must be straight between the coning parts and the lowest point, while on the other hand, if a cop is larger in the middle it indicates that the shoes have a high place between the coning parts and the lowest point.

When the internal shoe is set too far toward the front, this will cause a cop built with a hollow cone and produced by the long rail having a high place on it, or sometimes by the short incline on the front being too high.

Dwell motions are applied to mules to prevent snarls or kinks forming in the yarn when the carriage is at, or near, the beam. The rolls remain inactive for a brief period just as the carriage starts outward, which allows the yarn to be brought under a slight tension. To the writer, this motion is

as useful on a mule as split lap preventers are necessary on a picker. Split lap preventers are used in mills where the proper construction of a lap is little understood. This fact is proven by other mills making a perfect lap without the use of split lap preventers. The same can be said about a good mule spinner. He does not need the dwell motion to prevent snarls when he understands his business. No. 195.

CXCVI. HAND DRESSING PREPARATION.

Hand dressing is resorted to by manufacturers who want the very best results in dressing cotton warps, and it is admitted that a hand dressed warp excels all others in meeting all requirements, i.e., uniformity of tension, each thread laying side by side in the same place throughout the whole length of warp, no broken threads nor imperfect threads.

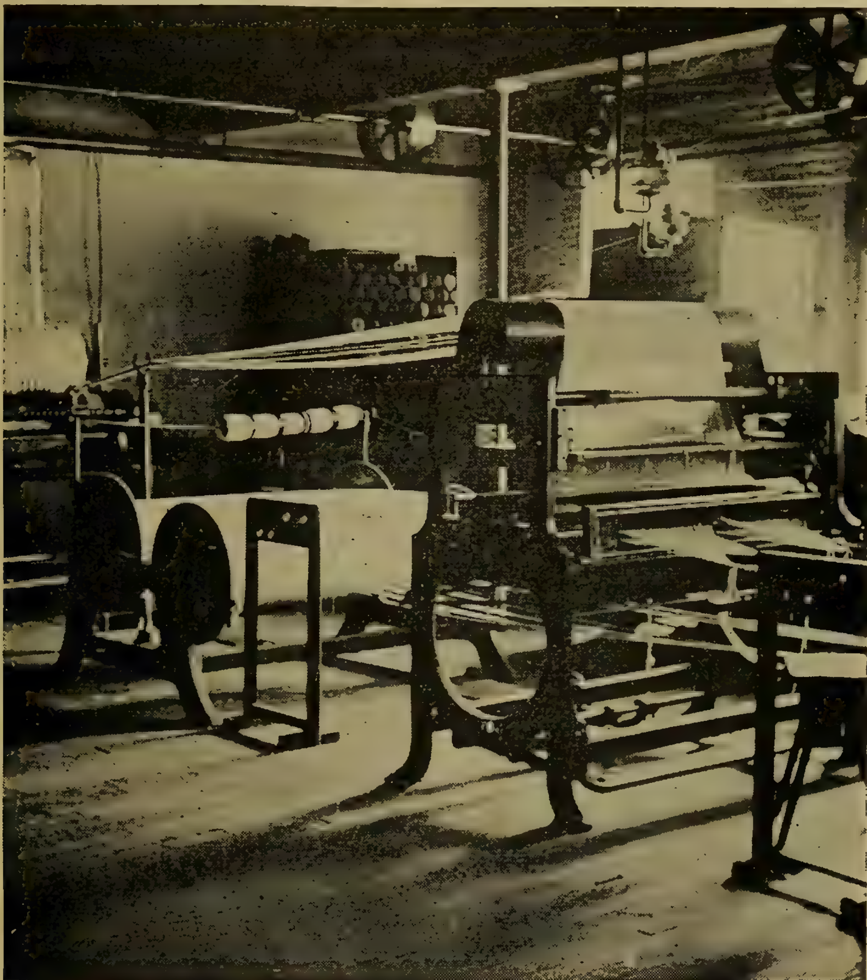


Fig. 68. Doubler—Three Beam Tie-Up.

It is the method used in the dressing of warps for the finest fancy fabrics. It is also really the only way to handle a warp of a thin sheet, as for instance, a warp taking about 25 per cent of the diameter of the yarn used, such as lusters or fabrics of this kind taking cotton warps filled with worsted filling.

On any other method of dressing these thin sheets the tendency is to make ridgy beams, on account of the open spacing of each thread in the warp. On the contrary, by hand dressing, the warp and the web on the beam is perfectly level, and will weave off with an even uniform tension.

Warps for hand dressing are prepared in various ways. By warping on section beams and then doubling on doubler, or by ball warping, or by a chain warper. The general product of the ball warper is not of the best. The warper usually contains tight and slack threads, which are very objectionable, for the tight threads are likely to break in the dye house, and the slack threads may get tangled and make a smash in the dye house. Even if these accidents do not take place, the warps do not make good webs. There seems to be no reason for these defects, only carelessness and defective conditions in the

WARPER AND BALLER.

To avoid tight threads in the centre of warp it is necessary that the creel is set back far enough from warper to allow each thread to unwind from spool freely without the thread rubbing up against the spool next above. If the creel is not far enough back from the warper, this is just what will happen, particularly if the spools are full. There is but one other remedy, and that is to reverse the spools affected and have them unwind from the bottom. This trouble is confined to the bottom spools of the first four rows on each side of creel.

Another feature that is productive of uneven tension is the practice of bunching the warp when the chain is in front of the return pulley. This is a most serious defect, and should be promptly eliminated wherever it is practised. Each thread of the chain should rest on the face of the pulley freely. By giving special attention to these two features in ball warping, the writer was able to produce the very best of warps by ball warping, and as these warps were made for his own department, he was in a position to observe their condition in every stage of progress to the finished warp on loom beam.

The

GENERAL DEFECTIVE CONDITION

of ball warps is, no doubt, one reason why the two other systems are used. Still there is another reason. When best results are desired from the dye-house, the work must be done within limitations. For instance, our dyer on short chain dyeing, which is the only way to get best results in variety of colors and level dyeing, refused to use a warp that contained more than 80 pounds of yarn, 1,200 yards in length, contending that with four warps to the run, a set of 320 pounds would take the color uniformly and would not be ended. That is, the first and last ends of the chain would shade the same. With a larger pound weight it is probable that his warps would be ended, as when the last end of the warp left the liquor the latter would be nearly exhausted. It is always dangerous to try to feed the liquor during the running through of a set, and is never resorted to in short chain dyeing.

If warps were made of 1-30, 80 pounds to the warp, there would be 1,680 threads of 1,200 yards long, and it would probably require two of these warps to make a web for the loom. To ball warps for this layout it would be necessary to creel 840 spools, so that the warps would dress from four chains—four chains is a favorite arrangement for hand dressing. The ordinary warper is not provided with such a creel, if it were, the finer numbers would call for a still larger

number of threads, and the difficulty would be further aggravated.

No. 196.

CXCVII. WARPING AND DOUBLING.

As the reputation of warps made on a ball warper is not very good, to get better warps resort is made to warping and doubling. It is generally believed that warping on to beams is better than on to balls, as any variation of tension of threads will make itself known by its appearance on face of beam and the warper tender will correct this quickly, whether it is a tight skewer, waste in reed, or drop wires, a thread of different number or defective yarn. If the warper tender fails to note and correct these bad conditions, the man on the doubler attends to them, so that they will not reach the dresser.

Chain warping is done on the Walcot Warper. This method of preparing warps is a compromise between the balling and doubling methods. It can use a creel with as many spools as threads could be used in the doubler, and the defect of the return pulley is eliminated as the yarn is taken up by full length drums around which each thread runs free, but the opportunity to inspect the yarn is wanting. This feature in itself would determine fine mills in favor of the doubler.

The latest style

DOUBLING MACHINE

is called the continuous process doubler. It consists of two side frames, some five feet high, with cross bracings, reed supports in front and back, one measuring roll and clock, one carrying roll. harness slide and one warp roll stand for two beams front and same in back. At a distance of not less than 20 feet is a mounted baller which does the winding of warp on to a ball.

As the preferential value of the doubler is in the production of a warp more uniform in its tension, it is important that beams warped are not ridgy, and to avoid ridgy beams it is necessary that there are enough threads to the width of beam to occupy all the surface of beam.

By experimental test it was found that the number of threads to the width of the 54-inch beam is the product of 100 multiplied by the square root of the number. Thus: 1-30 5.4772 multiplied by 100 equals 547 threads. Less than this number of threads is not safe in obtaining a good beam This method of ascertaining the number of threads to the beam width could be made applicable to any width of beam by proportion, using 54 as a divisor and the width of beam desired as multiplier.

We will take an order, say, for 8 warps of 1,680 threads, 20 cuts of 60 yards each, made from

1-30 CARDED COTTON.

The warping would be three beams of 560 ends, 9,600 yards, and the doubling would be affected as follows: two beams in front of machine and one beam at the back. On the front of back stand there would be put a roll, around which would be put one-half of the thread of first beam of front stand as follows: 140 ends retained at front, 280 threads run over the above mentioned roller on back stand, the balance of 140 being retained at front of doubler. This would leave the warp threads 840 at back and 840 at front.

By referring to Figure 68, it will be of assistance to the reader in obtaining an idea of the method used in tying-in a three-beam set in a doubler. The view is from the back of machine, and shows the preparation made. The beam and threads latched on after the threads of the previous set have been counted off and divided to suit new tie-up. Also by referring to Figure 69. which is a view of the machine from the opposite side, you will observe the position of the clock and shipping lever. It is at this point the operator stands when running the machine.

No. 197.

CXCVIII. TWISTING-IN SECTION BEAM.

For this order just described, a 12 reed is used on each side of frame and the threads are put in 2 in each dent. A rod is kept in the outer side of the reed to keep separate the two threads in each dent.

With 560 threads on one beam and the 280 threads from the opposite side of frame, there will have to be 140 threads taken from the full beam; pick up threads from this beam, 3 up and 1 down, the threads thrown down being twisted-in in conjunction with the threads from opposite side.

THE BOTTOM THREADS

in the reed are picked, one up and two down, and the threads from the opposite side are twisted to the down threads. The above 140 are separated as before and twisted to the threads picked up—140 plus 280 equals 420, the balance of the threads of beam being twisted to the upper threads of the two in the dent. This will be 420 threads running over and 420 threads running under the separating rod in front of reed on both sides of the doubler.

On the front side of the beam the threads from the two beams will be twisted on the same as the threads on opposite side. All the yarn will come from the beams in front when the twisting-in is completed. The doubler is started up and the yarn is run through reed over rollers and through harness to the overhead drum. On the knots reaching the baller a lease is struck and strings put in, the old chain cut away, and the ball of previous set taken off baller and replaced with empty roll to which the chain is fastened.

As this order calls for 8 warps, we will assume that they are to be dressed in doubles, and, therefore, the call order will require 4 warps with cut marks, and 4 without.

The gearing for the clock will be as follows: The yard gear works with one tooth to the yard, for instance, with the above order of 60 yards to the cut a 60-gear will be used. The cut gear is figured 4 teeth to the cut, and in the above order of 20 cuts would figure 4 multiplied by 20 equals 80 gear. A 40 gear could be used by running two raps instead of one to the warp. With a 60-yard gear and 80-cut gear on clock, and the lease taken, all is ready to start up.

Make first 4 warps, putting in cut marks, the cut lever ringing a bell and stopping the machine when the length is measured. The operator should be ready with his cut strings to tie them on. After these 4 warps the

CUT ALARM MOTION

can be thrown out of operation and the balance of warps to be made will run without stoppage, with the exception of putting in lease, which is always done at both beginning and end of warps. A ball will hold in this case 4 warps. Therefore, this order may be put on two balls.

In this order we have had to use 3 beams, and by doing so, there were unusual difficulties to overcome, as 2 beams had to be put on one side and one on the other. Half of the one beam had to be crossed to the opposite side and a pick-up made. Most sets, however, are made up of only 2 or 4 beams, and it is a small matter, the putting-in of a set. As in the case of a 4-beam set, the dividing rod at the back of reed separates the yarns from top and bottom beams on each side, and unless there are ends to be put in or taken out, the operator will only need to twist in his beam and proceed as in the above mentioned order. No. 198.

CXCIX. YARNS IN HARNESS

In explaining the filling of an order as specified no mention was made of the arrangement of yarns in the harness, nor how a lease was obtained. This point we will now take up.

In the above set there is 1,680 threads in warp, 840 threads entering the reed on each side of the frame. The threads on back side of frame

pass round roller and through the heddle loop in the harness. The threads on the front side of frame pass around roller and through the the opposite side, and it does not contain a thread-eye. This gives the yarn perfect freedom to pass in the harness, when not taking a lease,

Fig. 70. Dressing Frames—Front View.

harness, clear of the loop heddle, threads from each side being put in alternately.

The harness used in a doubler is made somewhat different than that used in a loom. The heddles on one side are looped into the heddles on and the loops meet all requirements when the threads have to be crossed for the second lease.

FIRST SINGLE LEASE.

The first single lease is obtained by passing lease stick up between the

rollers and separating the yarns from the back and from the front, carrying this separation through the harness on top of which a string is put in the constitutive first single lease—the second lease is taken by pulling over harness toward the front, bringing back threads which are in the loop toward the front of frame, causing these back threads to cross each of the front threads.

When this is accomplished, the lease rod may be passed through above harness, between the threads that are looped and the threads that are not looped. By running the machine a yard or so the string of the first lease and the lease stick will be brought into a convenient position to replace the rod with the lease string of the first lease.

In the process of doubling great care should be exercised by the operator that the beams are properly weighted. Each head on each beam having a rope placed in the groove and weighted with the least amount of weight possible, the rope fastened to the floor or beam stand at the front and encircling the head of beam in the direction it runs.

A close scrutiny should be made of the yarns as they come off the beams and if any imperfect or wrong threads come up they should be immediately tied out, replacing the yarn from beaten spool behind beams. No tight or slack threads should be allowed to go into warp and care should be exercised in putting in cut marks and leases.

COMBINATION TABLE.

The following combination table of section beams for warp dressing was found very useful. This table pretty well explains itself. The 2nd, 3d, 4th and 5th columns are headed with the number of threads on section beams The first column the number of threads in each combination of beams marked opposite under any of the other four columns. When there are two groups this indicates that there are two combinations to the same number of threads:

COMBINATION TABLE OF SECTION BEAMS.

	450	500	550	600
900	2			
950	1	1		
1000		2		
	1		1	
1050		1	1	
	1			1
1100			2	
		1		1
1150			1	1
1200				2
1350	3			
1400	2	1		
1450	2		1	
	1	2		
1500	2			1
		3		
1550		2	1	
	1		2	
	1	1		1
1600		2		1
		1	2	
	1		1	1
1650			3	
		1	1	1
1700		1		2
			2	1
1750			1	2
1800				8
	4			
1850	3	1		
1900	3		1	
	2	2		
1950	3			1
	1	3		
2000		4		
	2		2	
	2	1		1
2050		3	1	
	1	2		1
	1	1	2	
2100	2			2
		3		
		2	2	
	1	1	1	1
2150		1	3	
	1	1		2
2200			4	
		2		2
	1		1	2
2250			3	1
	1	1		2
	1			3
2300		1		3
			2	2
2350			1	3
2400				4

With various beams on hand containing the above number of threads, doubling can be done promptly on receipt of an order.

On the completion of the above order, the balls are sent to the dye house with instructions as to the shade or bleach wanted. In this case we will say 4 warps for red and 4 warps for black, and will proceed to describe the process of hand dressing, a 4 and 4 pattern of 3,360 ends, 1,680 black and 1,680 red. No. 199.

CC. A HAND DRESSING FRAME.

A hand dressing frame is constructed in such a way as to provide every facil-

ity to the dresser to control every condition that is likely to develop in handling chain warps. With this machine a dresser can handle the lightest and heaviest sheets, and a great variety of colors in combination, in chains of any size and numbers of yarn of any combination, producing a warp that is nearer perfect than can be produced by any other method. The accompanying illustrations, which are those of a large hand dressing room, will aid the reader to understand the following description of the process.

Figure 70 is a front view of a row of dressing frames. In front of each frame may be seen the chain warps running up to their friction boxes, from which, it may be observed, they pass to the back stand some 20 feet in the rear. This stand contains several

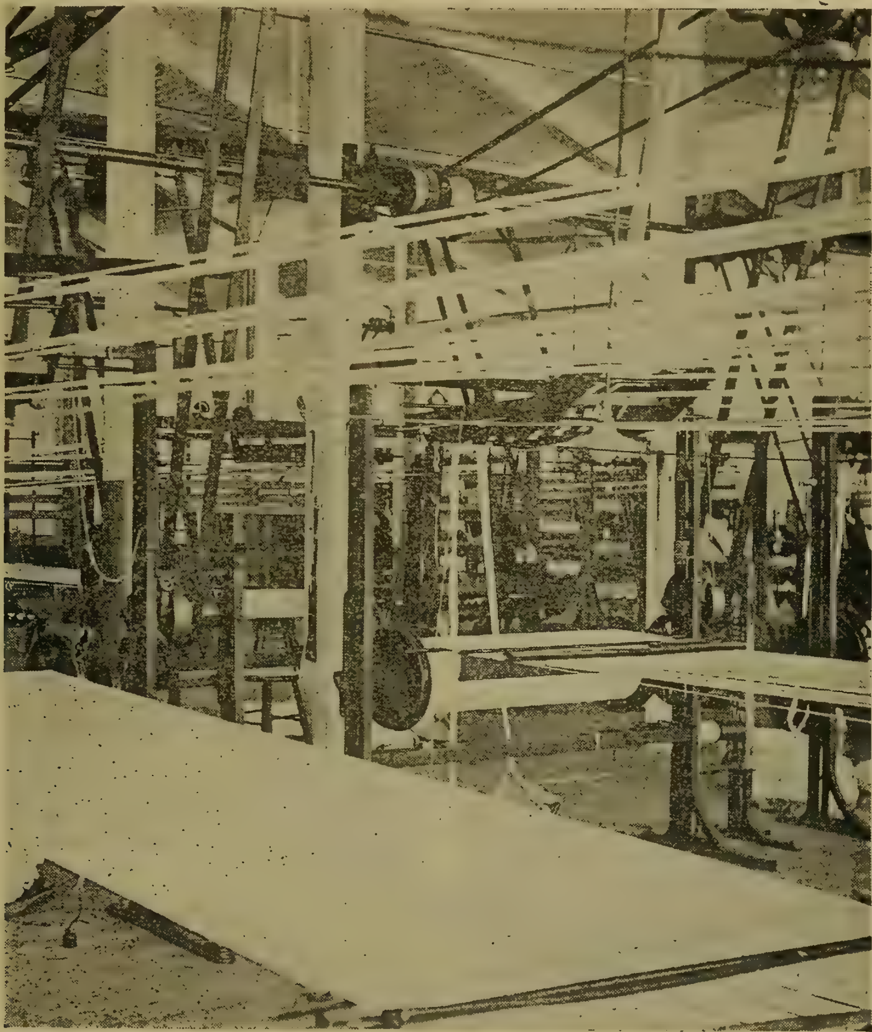


Fig. 71. Dressing Frames—Back View.

cross bars and a cross roll. Each chain in a warp is run around

A SEPARATE CROSS BAR.

The surface of each bar contains a series of notches. These notches are intended to hold the chain spread, and the whole warp passing around the cross roll and through a free reed to the loom beam which will be noticed is in the drive in the front frame.

In the front frame, Figure 71, in the foreground will be seen a warp where the operator has carried his reed back preparatory to winding on a reach. In the second frame you will notice the reed which the operator uses to guide the warp is run up to the beam, also the brush which he uses to open up the warp. The dresser stands between the back roll and the loom beam and controls the belt shipper with a rope which passes from the shipper around the whole frame front and back, and is always at all points within easy reach of the dresser. There are a series of 3 cone drives on the frame and on the counter shaft which enables the dresser to change his speed to meet all conditions.

On receipt of the above warps returned from the dye house colored, the overseer passes upon them as to shade, conditions, etc. If satisfactory, they were put into a weighing and lotted for by the men.

This method in giving out the work was in accordance with the wishes of the men, and by way of explanation, a weighing consisted of several warps which were all ready to be dressed. When one of the men fell, that is, ready for another warp, this man would report to the second hand and ask the number of warps ready for the weighing. With this information he would call for the number of men who fell next, all of whom would assemble in the warp room where the first man would prepare checks (marked with numbers) to the number wanted and place in a bag from which each man drew a check, the number of each having a corresponding number of warps placed there by the second hand just previous to the drawing of lots.

The dresser who received the warps, the preparation of which we have described, when ready to proceed would call for a splitting boy and would count off to the half of each of his black and red warps, splitting each half on to separate coils.

After the splitting was done, each strand was placed under and carried through the friction box and over the cross bars at the back, placing a strand of black and a strand of red alternately over separate bars. In front of the back stand a temporary stand was put to hold lease rods which were inserted in each lease of each strand, making in all four sets of lease rods. From these he would proceed to sley in his warp.

From the two leases of the black he would take one thread each and put them in one dent of the reed and repeat this in the next dent, making 4 ends of black. He would next take one thread each from the two leases of the red and place them in one dent and again one from each lease in the next dent, making 4 red threads. Continuing this sley until the whole warp was in reed, making a pattern of 4 black and 4 red, 420 patterns, 1,680 dents, 3,360 threads. This put in a suitable reed to get the necessary width for the weaving of the cloth.

No. 200.

CCI. HAND DRESSING.

This completed, the separating rods were put in between the double threads in each dent. Ths is done by separating the two top and the two bottom strands. The rod is fastened by strings on each side to the reed. A beam is secured and placed in the front drive and flanges adjusted to the proper width. The warp is now brought forward and latched to the beam. All overhead frictions are adjusted and the reed is brushed back, beginning the dressing by running up one reach, and adjusting the spread of warps in the back bars. Great care is used to see that yarns wound on the beam are level and that the face of the beam has no high or low places. After brushing back a few reaches a run is

started, the dresser standing a few feet in front of the beam brushing and carefully watching each part of the operation.

On finishing the warp, a lease is taken by picking up the lower threads in each dent of the reed that runs under the separating rod. This is done with the assistance of a peg which the dresser uses in his right hand to press aside the top thread in the dent, while with his left forefinger he picks up the lower thread. This is done very quickly by an experienced dresser. The separating rod provides the second half lease. After the lease has been put in, the warp is cut away, leaving the warp yarns in bunches about 24 inches from the lease. These bunches are fastened on to the warp and the beam is now ready for the loom and the dresser for another warp.

The above seems simple enough, but in the operation it requires skill to meet the usual conditions, replacing the out threads, tieing up the broken threads, taking out imperfect yarn, and doing this without crossing up the warp, regulating the spread of chain, carefully watching that each chain is working under the same tension and that each chain leaves its coil clean and free—all this in good warps.

But the dye house will not always return warps colored in a good shape. Sometimes they are not properly cleaned in the washing, sometimes they have insufficient size and at other times too much size, and sometimes the warp will be badly broken. All these conditions are common features in a dressing room. The above dressing is of a 4 by 4 pattern with warp provided exactly as needed, but if a call for warps is to be met by warps on hand, and these warps do not contain the right number of threads, as for instance, the order calls for four warps of the same quality and same style and the gray warps available are in double warps as follows: 1,200 ends 600, 1,000, 720, 1,700 and 1,500. The order on the dye house would be for a set of the above in black and a set in red and the dyer would run in the vat as follows: 1,200 and 600 in one strand, 1,000 and 720 in one strand and 1,700 and 1,500 in separate strands, in all four strands in one run of a dyeing set in each color.

On being received at the dressing room after being colored, the four warps would be put into the weighing as before the men received these warps, a splitting would be made, so that each man had a warp in each color of 1,680 threads, 20 threads being split from 1,700, 120 being split from 1,200 and 40 from 1,000. All these bits would be dressed in with the 1,500, making 1 warp of 1,680 threads. The balance of the 1,700 would stand for the second warp, the balance of the 1,200 and 600 combined would be for the third warp,

THE BALANCE

of 1,000 and 720 would make the fourth warp. Provisions would be made so that the warp that took the 1,500 and the three bits would not be dressed with the corresponding red warp, but would be dressed with a straight 1,680 thread warp. Each warp and bits would have to be reeded in the full width of the warp in each color. The dresser would exercise his best judgment in arranging the distribution of these threads and it would require skill on his part to handle these warps to get uniformity of tension. But for such conditions an allowance is provided for bits in the schedule of prices for dressing. (See price list.) This last illustration of a hand dresser's work indicates that a hand dresser requires skill and intelligence.

The above description of the various ways and means that are to be resorted to in hand dressing does not refer to the more complex work of dressing, such as Scotch tartan plaids, which in many designs take as many as ten colors, the preparations of which in splitting and putting in chains for dressing are much more complicated, but the same general procedure is observed. The reeding-in is from as many rods as there are colors and sometimes more, as the ground may take more than one chain. The reeding-in must be done according to the pattern and provision made for split-

ting the double threads in each dent for separating rod. It is very important that each strand runs free without rubbing.

The following is a price list which contains the usual rating for hand dressing:

PRICES FOR HAND DRESSING.

Special price in proportion to yards per cut.
.052 per 1,000 ends per cut of 72 yds. Grey.
.065 per 1,000 ends per cut of 72 yds. Black, bleach and colored.
.075 per 1,000 ends per cut of 72 yds. Spirited and C. D. Col.

PREPARING.

.34 per 1,000 ends per warp. Plain.
.51 per 1,000 ends per warp. Fancy.

EXTRAS.

.25 per wp. for cutting into two parts.
.12 per wp. for picking lease in wp. of 2,600 ends or less.
.15 per wp. for picking lease in wp. of more than 2,600 ends.
.12 per wp. for slaying off four pairs of rods.
.02½ per cut additional color for 72 yds.
.02½ per cut extra bit for 72 yds.
All bits to be picked in full width.

No. 201.

CCII. FRUIT OF MISMANAGEMENT.

The following statement of facts came under the personal observation of the writer when in the employment of the parties referred to and are written as words of encouragement to the efficient and words of depreciation to the inefficient in the hope they may accomplish good.

We had an order placed with us for French voiles which called for 800 pieces per week. The fabric was made of 2-40s worsted twisted wire twist. This is a twist of a multiple of 6 to the square root or about 26 turns to the inch in this number. This excessive twist is given the yarn to make it wiry. Instead of making this yarn of it's correct twist of 26 turns the mill order called for 30 turns, or the multiple 6.75 of the square root of the number.

Before dressing some of this

YARN WAS GASSED

and 7 per cent was allowed in the size of the yarn to allow for loss in the gassing, that is, the single yarn was spun 38s. On the weighing of a section beam warped to a different quality of the same lot of yarn before it was gassed, this beam contained 511 threads, 4,500 yards, the weight figuring as follows: 511 times 4,500, equals 2,299,500 divided by 11,200, the yarn yards per number to the pound equals 205.3 pounds. On weighing the beam, the gross weight was 438 less beam weight 165, equals 273 pounds of yarn. Per cent of difference 273 divided by 205.3 equals by per cent 32.97. Please note this yarn was about 33 per cent too heavy.

In the same lot

AFTER GASSING,

the weight was estimated as follows: Beam containing 515 threads times 4,320 yards, equals 2,224,800 divided by 11,200, equals 198.6. A weighing of the beam showed the following gross weight: 392 minus 156 beam weight, equals 236; percentage of difference, 236 divided by 198.6 equals 18.8 per cent given away to the buyer of the cloth.

This lot was sent along to meet orders for gassed and ungassed warps, and in both cases the number of the yarn was designated as 2-40. The above shows a loss of 11.4 per cent in gassing, but how did the management figure to obtain correct results from such conditions, and is it possible that there could be such a margin of profit on making this fabric that an overweighting of fabric 32 per cent (filling took same yarn as warp) would still stand for good profitable business? Nothing of the kind. This stupid piece of work meant the wiping out of margin of profit and a big loss, so we were using about 3,000 pounds of yarn per day, one-half of which went into filling.

The above does not tell

THE WHOLE STORY.

The amount of twist put in the yarn to its number was unreasonable and wholly unnecessary. The square of 6 is the proper twist 25.6 turns. 30 turns was excessive twist, but with yarn 32 per cent heavier, that is 2-26, the twist should have been 22 turn instead of 30 turn.

The yarn seemed impossible to handle. The warper had to be run

at a very low speed, and although it was usual to dress these warps on dry slasher, these warps had to be hand dressed from section beams of 3 beams to the set. From these conditions breakage was very great, and it was a problem to tie a knot that would hold and not untie in the weaving.

The above mentioned

EXTRAORDINARY CONDITIONS

were decidedly discreditable, that the management should select such excessive and impossible twist, that the same lot of yarn should have been assigned to meet two distinctly different orders at a sacrifice of not less than 7 per cent in weight, that the organization was so bad that there had been no check to the delivery of yarn so much over weight, the open weave effect of voile fabric eliminated the weaver as a check, but what about the perch?

This exhibit of inefficiency, in addition to the loss of pounds weight in yarns, increased the cost in each process, beginning with a 15 per cent reduced production in the twister, thereby increasing cost for twisting. A special price had to be paid for spooling, as the yarn was too lively to handle freely. Warper had to be run at a low speed, and even then stoppages were very frequent as the yarn was continually getting tangled. This doubled the cost in warping. In hand dressing these warps, the

COST WAS INCREASED

from .36 cents for slashing to 1.06 cents for hand dressing, about three times what it should have cost. The best results were not obtained in the weave room, as the excessive twist was felt here more than in any other process. The dresser could not get his warps as nicely on the beams as desired, and the nature of the yarn made it almost impossible to tie a knot that would not slip.

It is needless to say that there were many heartaches during the six months this order was running. Toward the end of the season a change was made in a reduction of twist by 4 turns per inch, and a greater care was exercised in spinning to the proper number. This completely changed conditions, but think of the leak. Not less than 4,492 pounds, this yarn selling at $1.25 per pound in dollars $5,614 dead loss as the fruits of administrative inefficiency. No. 202.

CCIII. FANCY CHAIN BEAMING.

Warps prepared in the chain to be ultimately slashed will be put on section beams with a chain beamer, whether they come from the dye-house in colors, blacks, bleaches, mercerized, etc.

The chain warps are made on a ball warper, and although the number of threads will make no difference in warping, it is very important that in beaming there should be a sufficient number of threads to the width of the section beam to have it level and not ridgy. This feature need not be considered at length when dealing with plain work, where all the beams of a set are of one color.

In ball warping such warps, the divison of the number of threads of the warp would be to the least number of beams that can be made conveniently. If the order called for 2,200 threads of 1-30 in a set, three beams could be made, two beams containing 733 threads, and one 734 threads. Most mills are not equipped with creels large enough to take 733 spools, but 2,200 divided by 4 beams equals 550, would be correct number for various reasons. This number would suit the ordinary creel; it is also a number of threads that will lay well on a 54-inch

SECTION BEAM.

This preparation of the proper number of threads in the warping eliminates the question of ridgy beams in the beaming, but in fancy work, where there is more than one color, there has to be some thinking and calculating done to avoid ridgy beams, and these kinds of beams are more objectionable in fancy work than in plain, as the unevenness of tension

will affect the prominence of colors in the warp design, and this effect will be variable, as a ridgy beam will deliver the same threads sometimes slack and sometimes tight. Keeping this point in view, the reader will readily understand why a number of colors are sometimes put on one beam in a mill, making fancy cotton goods, such as ginghams.

Figure 72 shows a beaming machine that is used in beaming both long and short chain warps on to section beams for the slasher.

driving pulley is a friction clutch pulley, and is connected to a foot treadle, so the operator can stop machine instantly, when an end breaks.

TWO COMBS

are used in connection with this machine, the front one being an expansion comb, and the other a swing comb.

In operating the beamer, the yarn passes over a guide or eye-bole, suspended from the ceiling, then through the guide eye on the tension end, passing around the drums of same,

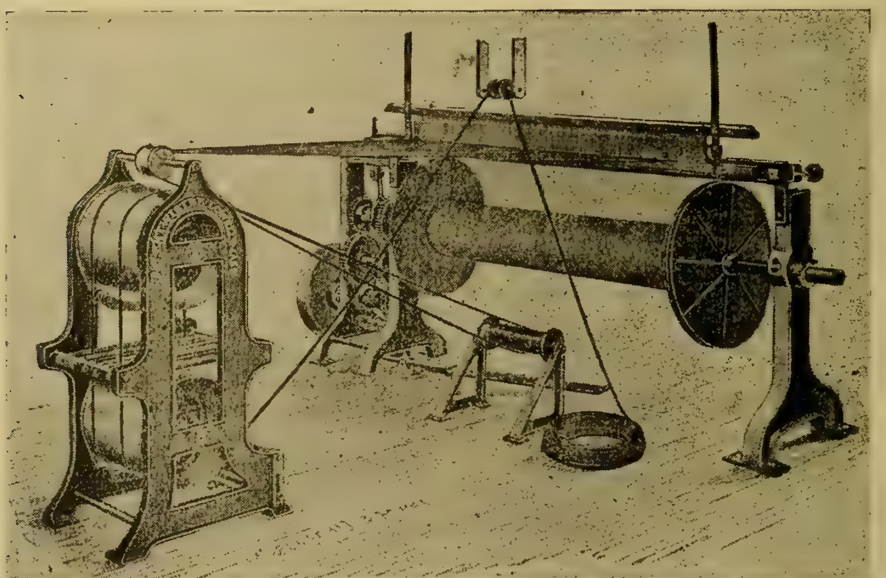


Fig. 72. A Chain Beamer.

QUALITY 3987 SCOTCH PLAID, DRESSER DRAFT.

Yarns.																			Threads in pattern.	8 Pats.	Extras.	Total thr. in warp.	Sec. beams.	Style 27 colors.
2/50s comb. A...	8								8										16 × 8	128		128	128	Yellow
1/30s card. B....		2						2		2								2	48 × 8	384		384	384	Black
1/30s card. C....			6				6				6			9			6		153 × 8	1,224	21	1,245	2—624	Green
1/30s card. D....				8		8													16 × 8	128		128	128	Red
1/30s card. E....					9							48				48			105 × 8	840	96	936	1—540	Blue
																							{396	
2/50s comb. F...			—				—				—		8		8		—		16 × 8	128	16	144	1{144	Red
			6×				6×				6×						6×		—		—	——		
									Start							Finish			254		133	2,965 in all 5 sec. bms.		
									6							6					thr.			
									on C.							on C.								

The driving of the machine is arranged with clutch gears, so that four different speeds can be obtained. The

then around a floor stand, back to the tenison end, around the wood roll, then to the Swing comb, which frees

the yarn of snarls before entering the expansion comb, which lays the yarn evenly on the beam.

The above illustration shows but one color being beamed, and only one strand. But in the making of fancy work, where there are a large number of colors, it is frequently required that more than one color be put on one beam, and to illustrate the method used in beaming fancy warps of various colors, we will take the draft of a design for a Scotch plaid as on previous page. No. 203.

CCIV. BEAMING FOR SCOTCH PLAID.

In the above draft will be found the whole design in warp layout, with particulars as to yarns used, threads in pattern, number of complete patterns and threads of each color, and with the added extras the total number of threads of each color in warp section beams and colors to the style.

By referring to the pattern, it will be noted that at the third repeat groups, the start of the pattern is indicated; that is, six threads of Color C followed by 48 threads of color E, and the fourth repeat group. Finish of the pattern is indicated six threads of C, preceded by 48 threads of E.

GREAT CARE

is always exercised when laying out the design of a warp to have the pattern on each side of warp finish the same. This has been done in the above warp, which begins with six of green and finishes with six green, 48 of blue coming next on both sides.

This layout for beaming, as indicated above, is for five beams, three beams with one color each, one beam with two colors, and one beam with three colors. C color will have two beams of 624 threads each, and E will have one beam of 540 threads. The balance of E color will go on same beam as F, and will be put in raddle in the following pattern:

Color E............	22		22	396 threads
F............		16		144 threads
				$60 \times 9 = 540$

A B D colors will go on one beam, and will be put in raddle as follows:

Color A...............		8				8	16	8	128
Color B...............	24		12		12		48		384
Color D...............				16			16		128
									630

In the quality outlines, colors are represented by letters, but we have added colors of one of the styles at the end of draft. It is probably best to explain that quality refers to outline of design, and that style refers to the colors that are used in the quality outlined. There are usually many styles to each quality, each style having a different

COMBINATION OF COLORS.

In putting a warp in the beamer made up of more than one chain, each strand should be provided with a separate eye-bole or guide, and as far as possible, kept separate, when on friction drums. The tension on each chain is determined by the number of times each chain passes around the tension drums, and the drums should be at least 20 feet from the beam, the longer the space to a certain point, the better the results. With a good long reach, the yarn is well opened before it reaches the swing comb.

Each chain should be kept separate as it passes around the wooden pulley on the floor, also as it passes over tension end roll. In beamer used for varied colors, provision is made particularly at tension end to have as many pulleys as there are colors, each of a different diameter. This prevents the chains from rubbing each other as they pass to the raddle. In addition to the above provision, it is well to put rods between each color.

Each chain has always a lease at both ends, and if it is a long chain, there will be several leases throughout its length. These leases are to enable the beamer man to straighten out his warp if it should become tangled or crossed up.

PUTTING IN CHAIN.

We will now proceed to hang the

two C and F chains up, that are to be put on one beam, each color or chain will be put into a separate eye-bole and carried through the eye to the tension end, passing each through between different guides, each chain being put around the tension drums twice, and to the pulley on the floor back to the tension end, and each put around a separate pulley, the E color around the smallest pulley, the F color the largest pulley, both being carried forward to the raddle. The swing raddle should be removed, and the yarn laid in front raddle in the rotation of the pattern for two-color fancy beam, via 22 threads of E, 16 threads of F, then 22 threads of E. On repeating the pattern, 22 threads of E will come next, and make in all 44 threads of E laying together. This will continue throughout until the finish of laying in, when there will be only 22 threads of color E at the end.

These ends will be fastened onto the section beam and a short start of a few yards made, when the raddle will be adjusted to width and position. When this is done, the swing reed or raddle will be brought up under the chains, each wire of the reed passing through between each thread. This completes the preparation. No. 204.

CCV. BEAMS LAID IN WARPING.

This same procedure will be observed when the beams for three colors are laid in. In warping for these chains, it is always considered expedient to put at least one thread extra in each color to be available to tie up breaks or replace ends out. Some mills will provide the men with a length of yarn of each color, which they hang up convenient to the position they are required to take, when running the machine. The operator stands in front and holds the sewing reed in hand, and a good man will manipulate this reed to excellent advantage in opening up his warp, and preventing breaks. The shipper is in a very convenient position, and responds promptly to the pressure of the foot of the operator, who is also in a position to see just how the warp is going on to the beam, and adjust his front raddle by shrinking, expanding or raddling to either side. On finishing a section beam, a lease is picked and

STRINGS PUT IN.

On the completion of these beams, we are ready to put them in the slasher, but before doing so, we will

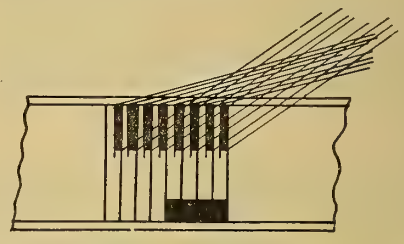


Fig. 73. Section of Block Lease Reed.

describe another way this set may be prepared, and we think the most common way, but if quality is a consideration, the above is by far the best, as by laying out for five beams, a uniform tension is obtained, the warps will weave well and the cloth and the design will be uniformly balanced.

The objection to this layout is that there will be four beams that will be disposed to be ridgy. This layout is also suitable for a slasher that is equipped to take a lease.

Chain beaming is usually paid for by the piece, so much per 1,000 yards. Some mills on plain work class it in two grades, coarse and fine, paying 19 cents per 1,000 yards for coarse, and 25 cents for fine. In fancy mills, the prices are scheduled per 1,000 yards for a number of threads and number of chains used. The following is the schedule used in a leading mill:

LONG CHAIN BEAMING PRICE PER 1,000 YARDS IN ALL NUMBERS.

Ends.	Price. Cents.	2 Chains.	3 Chains.	4 Chains.
From to..350	16.5	18.	19.	20.
351 to......400	17.	18.5	19.5	20.5
401 to......450	17.5	19.	20.	21.
451 to......500	18.	19.5	20.5	21.5
501 to......550	18.5	20.	21.	22.
551 to......600	19.	20.5	21.5	22.5
601 to......650	19.5	21.	22.	23.
651 to......700	20.	21.5	22.5	23.5
701 to......750	20.5	22.	23.	24.
751 to......800	21.	22.5	23.5	24.5

There are a variety of ways in slashing these warps. Some mills are in the practice of putting their fancy beams in the slasher in the ordinary way, as with a set of grey warps putting in the three color fancy beam in the front beam stand, next the two color beam and then color E beam, the two C beams being at the back.

In addition to putting in the usual strings to separate yarn from each beam, the colors are separated, and when the set reaches the front, the design is picked in the raddle. As each loom beam is taken off the slasher, a string is put in separating the colors, the beam then being taken and put on a stand, and girls would pick a lease in each color.

Some mills prefer to run each beam separately and run the warp through an ordinary reed at the back of slasher, treating loom beam in a similar manner by picking a lease, only beams would be reversed, the three color beams would be put in back stand, instead of front, etc. As the purpose in arranging the beams is to have easy excess to the greatest number of colors, however, the most up-to-date method of slashing fancy color warps is by using a block reed at back of slasher by which a lease is obtained.

No. 205.

CCVI. SLASHING FANCY WARPS.

In this warp we have been considering that the design is not easy of arrangement to be handled in this manner, but the design was selected so that the writer might explain away difficulties in chain beaming fancy work in preparation for slashing, and will now proceed to explain the putting in of a set in a slasher equipped with a block reed placed in front of size box, and

ARRANGED TO TAKE A LEASE.

By referring to Figures 73, 74 and 75, the reader will better understand the explanation given, and will note in Figure 75, that there are five beams in this set tied up. This set will be cut down, but before doing so, the attention of the reader is called to the split

SECOND BEAM ARRANGEMENT OF SET FOR QUALITY 3987.

A	128					4				4			64
B	384			Two pattern	6		6		6		6		192
C		1245		beamed made									
D	128			as follows.				8					64
E			936										
F	144					8						8	72
	2/392	2/623	2/468			8 times						1 time	2/392

in the middle of third beam. This is necessary, as the two threads in each dent of reed have to be kept separate, therefore, one-half of middle beam will be on each side of lease rod in alternate threads, accompanied by the threads from two beams each.

The first arrangement of beams for the slashing of the quality outlined will not do, but the second arrangement of threads in colors and beams meets all requirements.

The old set is cut out in front of the block or lease reed one yard from reed. Beams are taken out and replaced with beams as arranged, six beams in all, put in beam stand as follows:

		Threads.
1st beam col.	A 64, B 192, D 64. F 72	392
2	E	468
3	C	624
4	C	624
5	E	468
6th beam col.	A 64, B 192, D 64, F 72	392

After beams are put in back stands,

Fig. 74. Rod and Lease String.

lease rods are put in to replace lease string in each beam, and all brought

forward to lease stand, ropes weighted having been put on the beam heads. After all these preparations, the slasher man proceeds to twist or tie in his warp onto the threads in the block reed. Care is taken that whatever color is wanted in the pattern when twisting in, each successive thread must come alternately from the front three beams and the

BACK THREE BEAMS.

Please note this, as we twist in the warp, as this is a very important feature; it determines the allegment of threads in the lease. Refer to pattern draft, while following the twisting-in of the warp. Start six threads of C on the third repeat, taking one thread from third beam, one thread from fourth beam and twisting onto yarn in first dent in reed. Repeat this three times on threads of successive dents, now one thread from second beam, and one from fifth, this 24 times, making 48 threads of F.

Now, one thread from first beam and one from sixth beam, four times, making eight of F; now two threads of C, third, and one-fourth, now one-third C, and one-fourth C three times, in all, nine threads of C. This will put a flat in the lease, but it cannot be avoided to advantage, but the double threads should be taken an equal number of times from back and front beams.

By continuing to twist in the pattern, as indicated, the warp will be completed, and all threads twisted in, finishing with six threads of C at the fourth repeat. All lease sticks should now be taken out, and a splitting rod put in to keep separate the yarn from the three front and the three back beams. No. 206.

CCVII LEASING IN A SLASHER.

Now run the warp forward a little, and take lease rod and put it on top of warp in front of reed, pushing the warp down to the bottom of reed. By doing so, you will get a pin lease of eight threads each way; put rod and string, Figure 74 in lease, pulling out rod and leaving in the string run forward a little more. Next take the rod and string, and put it through the half lease for the splitting rod at front; see that the size is in box, and steam

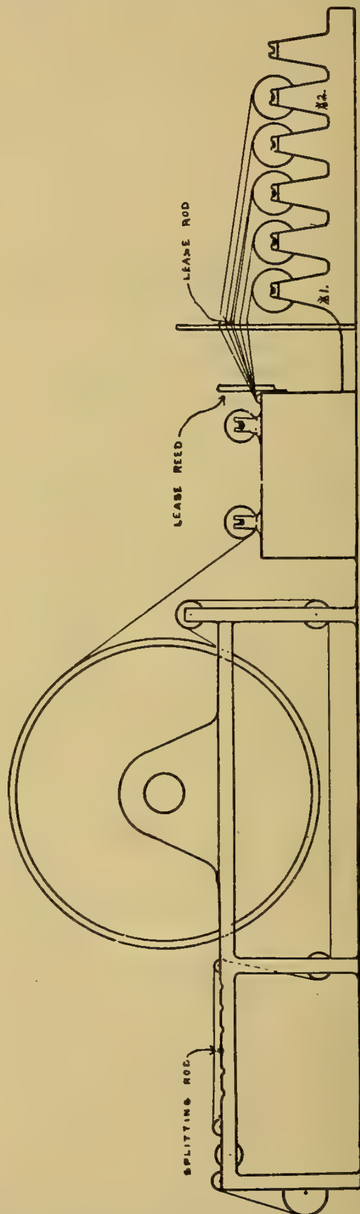


Fig. 75. Slasher Containing Fancy Set.

in the cylinder; now start up machine, and run the strings through to the front, when the first string is close up to the raddle; go over raddle, and

see if all the threads are properly in the comb; that is, eight each dent. Now, put in your dividing rod; take off the full loom beam, and put on empty beam latch on warp and start up slasher. On the finish of beam, a lease is struck at back reed, as follows:

Take a lease rod and run it through where the splitting rod is between the yarns of the front and back beams; push it close up to the reed. This will separate the two threads in each dent. Take another rod with a string in the end of it; run it through between the yarns parted at the back of reed; leave the string in and pull the rod out. In doing this, you have got your first lease.

If the reader will closely observe the constructions of section of block reed at Figure 73, he will more easily understand that in

TAKING SECOND LEASE,

the bottom threads on first lease have to become top threads at second lease. To make the change, a hook is provided in each dent of reed by a lead block. Pull the reed over and raise the yarn on top into hook; now push the yarn over the opposite way and pull out lease rod; put it under the bottom yarn and pass that half of the yarn free of the hooks to the top of reed, slipping a lease rod through at back of reed and

RUNNING THE WARP

forward a few inches; then putting in lease string, replacing rod.

Run the machine a yard or so, and put in string in shed for dividing rod, start up machine, and run the leases through to the front, and when the lease strings are close up to raddle, take a flat rod, putting the end between the strings (which are double), push it through, putting it close up to the comb, placing it edgewise; then take the rod and string, and put the string through the front of the comb. starting the machine a little. Do the same with the bottom string, and we have the lease completed. We now put the splitting rod where the last string is, leave it in its place at back of comb, cut out the full warp, put in empty beam, and start up for second run.

In this method of slashing fancy warps, all warps must be colored fast, as colors cannot be run separately through different size boxes. This feature may be assigned as the reason why mills which color warps with cheap dyestuffs are not equipped to take leases on their slashers. Where fugitive colors are used, the extreme shades have to be kept separate when sized in a slasher by running them through separate size boxes. But most high-class mills use the block reed in their slashers to get a lease. By so doing, they obtain warps that shed freely in weaving, and cross threads in the warps are reduced to a minimum.

No. 207.

CCVIII. IMPORTANCE OF SYSTEM.

In these progressive times, when the importance of system in all the activities of life is being emphasized not alone in the business world, but in all our educational institutions, it is but natural that the employer should expect the new man to be systematic and methodical, and if the latter succeeds a man of the old school, whose ideas of economy were confined to a close scrutiny of the pay roll, and a continual driving of the help who worked under him—one who had but the faintest idea of securing statistics to base his understanding of labor and machine values in production and cost—the new man will have to organize his department in the absence of records, to obtain all facts as to labor and machines and at the same time run the department to keep up with the work.

It may be said at this point that there are few responsible positions in mills that are alike in every particular, and when a man takes a new position, he will invariably meet conditions that are different in many ways from those of his previous experience The carder will probably find that the equipment will not balance the same as in his previous position, and to meet these conditions, he will have to draft

his machines differently. The spinner the weaver and the finisher will invariably have to adapt themselves to some features that are distinctly different from their previous experiences, and the new overseer's adaptability is a feature that will, more than any other, determine his success in his new position, and particularly is this applicable to the

OVERSEER OF DRESSING.

An experience such as is mentioned above came under the observation of the writer, and the following describes the development from an administration by sufferance to a well-organized department, where the overseer had a line on every process, machine and worked in the department, providing exact data of the labor and machine values as a basis for cost finding, and enabling the overseer to effect improvements where there was evident weakness and balance the department to meet all demands of the weave room.

At the time the new man took hold of the position referred to, the equipment consisted of two departments, slashing and hand-dressing, each being controlled by second hands with all sorts of licenses in the handling of orders. The slashing department had four slashers, one of which was a dry slasher. There were also ten warpers, five Draper spoolers of 100 spindles each, and ten Moore quillers of 30 spindles each.

This department was manned with a second hand, four slasher men, four helpers, two warper and beam men and one man to bring yarn up to the spoolers and quillers. Each side of spoolers and quillers was run by a girl, and each warper girl had one frame. At this time, a large proportion of worsted yarns used were bought from outside yarn mills.

The

HAND DRESSING DEPARTMENT

consisted of 62 frames in rooms scattered all over the plant, two Scotch warpers for dressing overlines, three upright sample frames and one splitter. This department was manned with one second hand, one third hand, one man to each frame, and three boy splitters, one machine splitter, one beam man, one belt man, two men for warpers, second hand on samples and three sample dressers, two men for warpers, second hand on samples and three sample dressers, six leasing girls, three office girls, two men to take care of all shipments received in of gray warps, yarns, etc., for both departments. No. 208.

CCIX. REORGANIZATION FIRST STEP.

The matter to be given first consideration was the establishment of a correct understanding as to the number of warps to be prepared for each class of looms in the mill. To meet the looms' demands, there was a sort of a general rule that there had to be dressed 1,000 60-yard pieces each day, 250 in slashing department, 550 hand dressed, and 200 pieces slashed from beams, the yarn of which was colored black on the beam. These pieces were slashed on a special slasher in the dye-house.

There were no call lists provided, and the overseer of dressing would, as a general rule, dress the warps he had yarn for, and wait supplementary information from the main office. This information was generally delivered by the overseer of weaving, who, on finding himself running short of warps for some particular looms, would call on the main office for information as to what was coming next, and would be advised that the dresser had suitable orders on his books, but chain warps for these orders were not yet delivered, and was requested to see if the dresser could arrange to use some stock warps that the looms might be kept running. This was not a very desirable move for the dresser and his room, and met with his opposition.

TEAM WORK LACKING.

The weaver was in the habit of calling for warps ahead of his needs. Of this the old dresser knew, and having no data as to loom requirements,

would act stubbornly, and, as a result, there was continual friction between the weave room and dressing room.

The weaver had an advantage in these circumstances, and when his weave room production did not show normal he would complain about his looms being stopped for warps. These conditions did not fit the new man, and in his effort to mend things, he had the opposition of the weaver who wished to let what he called "well enough alone", but this harassing condition had to be eliminated, and without the assistance of the weaver, a table was made out, covering 18 kinds of looms, number of each, speed and width, average picks of fabrics woven in these looms, and a 72 per cent production constant for 10 hours. This constant, when divided with the number of picks, is the yards per loom. Multiply the quotient by number of looms, and divide the sum by yards per cut, and the result will be the number of cuts that must be dressed on an average per ten hours.

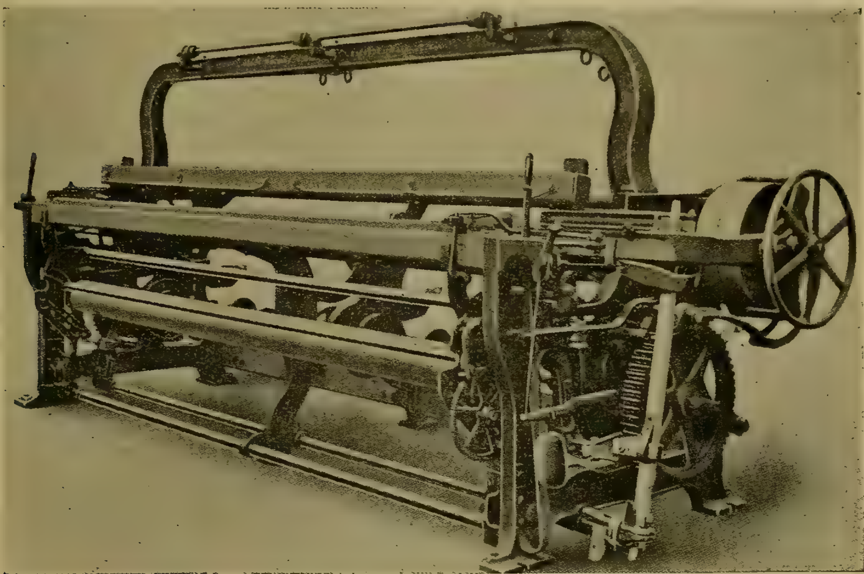


Fig. 76. Cam Loom.

	Looms.	Speed.	Width looms.	Average picks.	10 hr. constant.	10 hr. yards.	60 yds. cut.	Surplus beams.
1........	156	155	46 Dobby	68	1860	27.35	71	32
2........	48	145	46 Jacquard	56	1740	31.07	24	10
3........	263	155	46 Plain	68	1860	27.35	120	53
4........	352	145	50 Dobby	60	1740	29.	170	70
5........	72	125	50 Jack	56	1500	26.79	32	14
6........	63	125	50 Jack 6 × 1	56	1500	26.79	30	14
7........	114	125	50 C. Cam.	68	1500	22.05	41	23
8........	119	130	60 C. fancy	56	1560	27.85	55	24
9........	129	125	64 C. fancy	56	1500	26.79	57	26
10........	24	125	62 C. Cam.	32	1500	46.87	19	5
11........	36	130	61 Plain	32	1560	48.75	29	7
12........	204	125	72 Atherton	32	1500	46.87	160	41
13........	24	125	72 Plain	52	1500	28.84	11	5
14........	24	125	72 Plain	52	1500	28.84	11	5
15........	205	125	72 Fancy	70	1500	21.43	73	41
16........	124	125	82 Fancy	70	1500	21.43	44	25
17........	125	145	46 Dobby	66	1740	26.36	55	25
18........	111	145	46 Cam.	56	1740	31.07	55	22
	2,198							442

The last column in the preceding

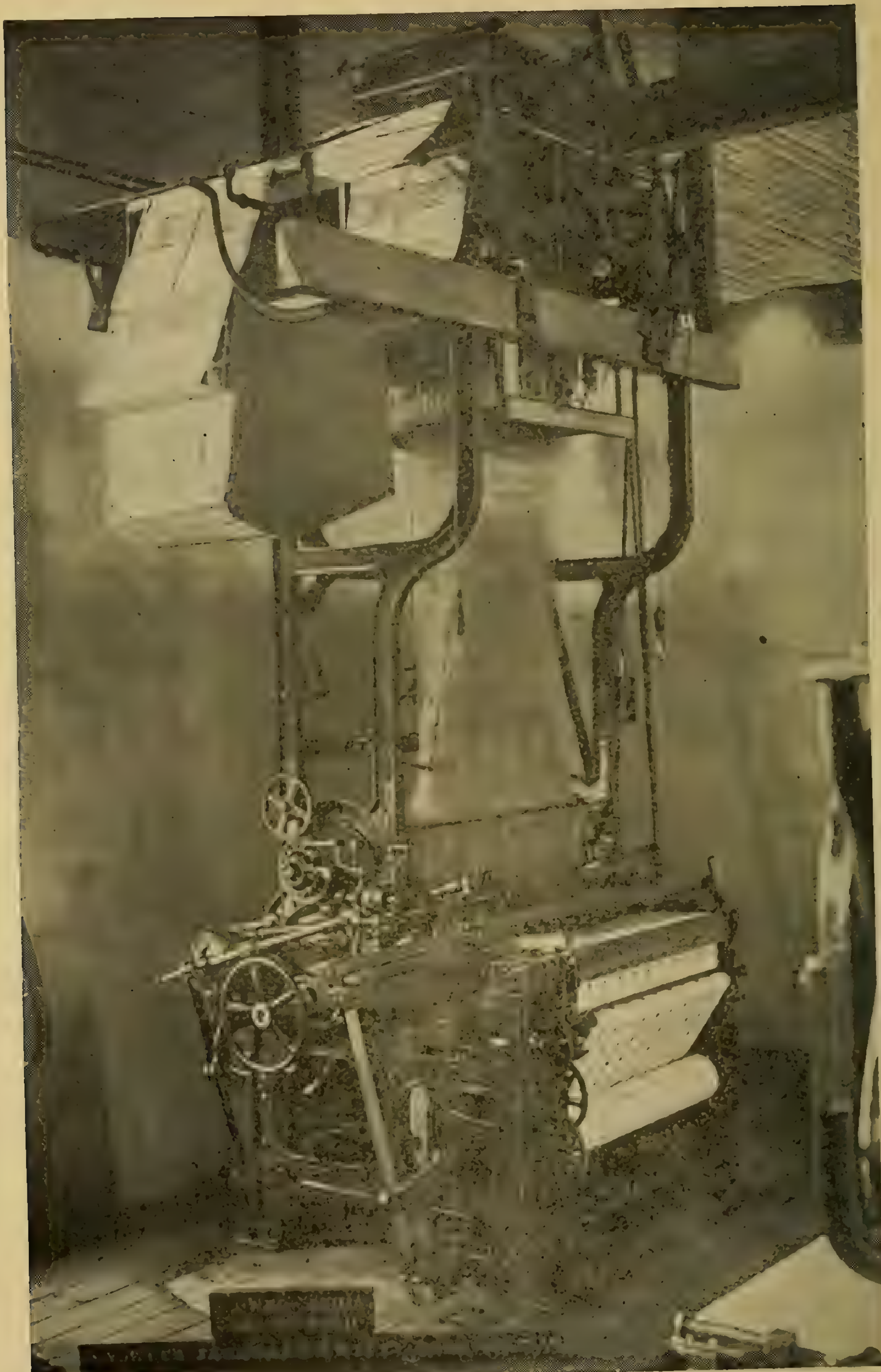


Fig. 78. Jacquard Loom.

table is the number of beams or webs that should be ready on the floor dressed for each kind of loom. This is figured at 20 per cent of each class of looms, for example, the first item in the table is: 155 speed times 72 per cent equals 111.6 speed times 60 minutes equals 6,696 picks, divided by 36 inches equals 186 yards 1 hour, times 10 hours equals 1,860, divided by 68 picks equals 27.35 yards times 156 looms equals 4,266 yards, divided by 60 cut yards, equals 71 cuts.

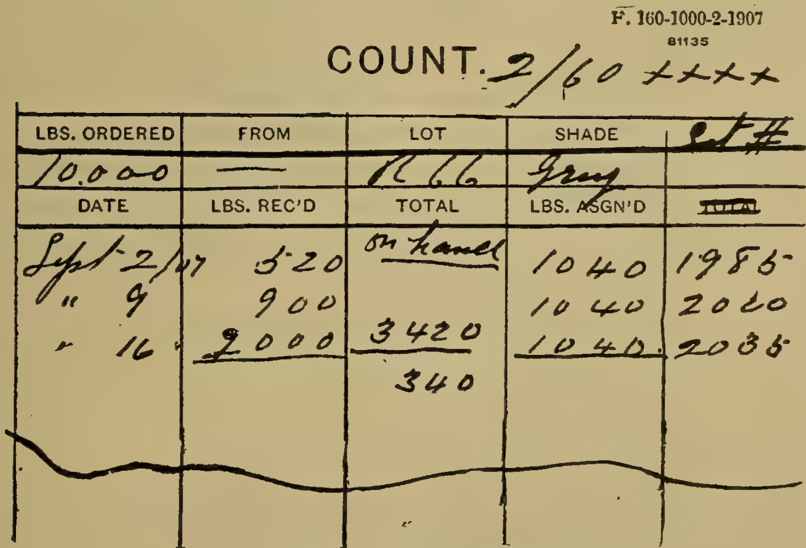
When the matter was taken up with the superintendent, he agreed to see that a report of warps on the floor in the weave room be furnished the dresser each day. This list plus the warps dressed on the floor in the dressing room gave the dresser

A WORKING BASIS.

The report of warps on the floor would be set against the last column n the table. This would indicate just what must be done to keep the looms going, and at the same time the ninth column will indicate what must be dressed on an average to supply warps for each kind of loom.

Another irritating feature was the habit of the weaver to suit his own convenience in selecting the beams on which he chose to have warps put, as, for instance, on getting a new quality to dress the weaver would state the kind of beam to put these warps on. Suppose he said a 46-inch beam; when these warps went to the weave room, if a 50-inch loom was empty, he would just as soon put the 46-inch warp in as not, and it eventuated in their being a shortage of 46-inch beams, and 46-inch looms were waiting for warps. It may be mentioned that narrower beams will run all right in a wider loom, but the rule will not do when reversed by the above table, and by carefully watching the weave room, this most important matter was remedied.

The orders for the department were received on slips, on which was designated the quality, style (and if plain, the number of the color), and pieces called for of each style. If fancy, a supplementary draft sheet was received, giving the lay-out of design, etc. There was also marked on this slip the number and kinds of yarns, and if the orders were for cotton warps, there would be written on this slip information as to where warps would come from, and the firm they were ordered of. If slasher warps, the order would designate from where the yarn


F. 160-1000-2-1907
81135

COUNT 2/60 xxxx

LBS. ORDERED	FROM	LOT	SHADE	Lot #
10.000	—	[illegible]	Gray	
DATE	LBS. REC'D	TOTAL	LBS. ASGN'D	~~TOTAL~~
Sept 2/07	520	On hand	1040	1985
" 9	900		1040	2020
" 16	2000	3420	1040	2035
		340		

Figure 79. Stock Card.

was coming, the pounds ordered and nature of contract as per weekly deliveries.

This information was recorded in a book provided for that purpose, and also all particulars as to orders, was slashing department, and reference was made to the main office only to ascertain how orders for yarn stood when the yarn seemed to stop coming in. The man in charge had no way of checking the yarn, and there was no

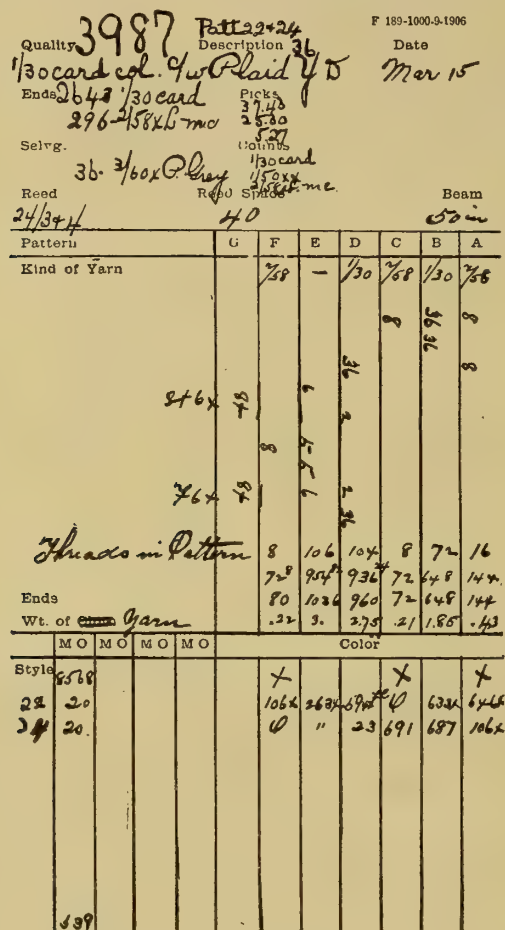


Figure 80. Quality Card.

entered in the overseers' book for his information and guidance.

All slashing orders were recorded in a book in the slashing department, and the order slips kept by the second hand, until the order was completed. At that time, it was returned to the overseer and filed with all orders that were completed. Pounds of yarn received were reported to the main office, but no record was made in the security against

THE MIXING OF LOTS,

nor was there any way whereby the yarns going into a set could be traced back. Yarns of the same number and the same quality were being received in this department at the same time from as many as five or six different companies. No. 209.

CCX. CARD SYSTEM.

The temptation to be careless and mix lots was too great, and to eliminate this condition, a system of cards made of cuts dressed on each style. Figure 80 shows the record as made of a fancy quality, which will be hand dressed, and will be referred to later on, but the record of plain work will not contain so much detail, and in was adopted. Each order as it was received was transferred to cards, yarns required to the stock card (Figure 79), the number of yarn, lot, shade, pounds ordered, from whom, date, pounds received and total pounds on hand; also pounds assigned and number of set.

On a quality card, Figure 80, all detail was recorded, if fancy warp, lay out in draft, description of grade and width, date of the receipt of each order, yarns in number and grade, ends, picks, selvage counts, reed, reed space, beam width, pattern letters of colors in quality, kinds of yarn, layout of warp draft, ends in pattern, ends in warp, weight of each kind of yarn styles, colors of each to the letter of the design, and the M. O. number (manufacturer's order). On the opposite side of the card, records were the case of the slashing, grey work, instead of a fancy warp draft, the detail of section beams was written in as in the following illustration.

Quality 3855, description, 54 inches. Chiffon panama, ends 2968, picks 52

No. 1 beams	594 ends,	2.6 pounds per 72 yards
No. 2 beams	594 ends,	cut, 3% being allowed
No. 3 beams	594 ends,	for shrinkage.
No. 4 beams	593 ends,	
No. 5 beams	593 ends,	
	2,968 of 2/60 xxxx	

All

ORDERS FOR SLASHING

sets were issued on ticket, Figure 81, by the overseer. This is the same quality referred to above, the date of the issue of this order, the set number and the number of cuts were recorded on the back of the quality card, the pounds assigned and the set numbers were recorded on the stock card of 2-60 grey lot R 66, the gearing, 72 yards gear, 40-cut gear, instead of 80 gear, and eight rapes instead of four rapes.

Figure 82 shows two warpers tied up for different purposes, one for section beams for slasher or doubler direct, and the other for chain warps for the dye-house to be colored, bleached or mercerized. In this illustration, there can also be seen two spoolers and part of a twister.

The rule in selecting gears for this warper clock was yards gear, as specified, cuts gear as specified, and always four rapes, with a different arrangement of gears, as in the above. To figure the product of a set of gears, multiply one by the other, and divide the sum by four. Multiply quotient by rapes; thus:

$$72 \times 40 = 2880 \div 4 = 720 \times 8 = 5760.$$

There are five beams called for, as recorded on quality card, and there are 80 cuts called for. Therefore, pounds per cut (see quality card, Figure 80), 2.6 times 80 cuts equals 208 pounds per beam, making in all, 1,040 pounds, which are credited on stock card, as pounds assigned No. 210.

CCXI. CONTROL OF SETS.

A board containing pins, one for each warper, was used to hang set tickets on. Each set, when made out by the overseer, was placed on the pin of the warper on which he desired to have it warped. This gave the overseer complete control over the detail of the warping. This was very important, as there was a very large number of different kinds of yarns used of different numbers in single and twist, and various sizes of creels, raddles and section beams, of which data was kept in the office, and was available for the overseers' use. This enabled the overseer to avoid tying on single to twist yarns a small tie-in to a large tie-in, avoiding numerous complications, and keeping the driving belt on the tight pulley.

The second hand was expected to see that each warper had on her nail, beside her frame, a set card, and as

F.142-2000-5-1907

CLOTH DEPARTMENT

DRESSING 20

DATE Sept 16 07

QUAL. 3855 SETT. 2035

COUNT 760 GRADE ++++

COLOR Grey LOT R 66

GEAR 72 40 SCORES 8

Beams	Ends	Yds.	Lbs.
201 √	594	5760	208 √
182 √			√
153 √			√
174 √	593		√
195 √			√
	2968		1040

82 Knowles 62

SEP 28 1907

J. G.

WARPS	CUTS	YARDS
6	4/13 2/14 80	72

Fig. 81. Set Card.

each beam was made, a check mark was put on the ticket opposite beam made. By this method,

THE SECOND HAND

or the overseer could see at all times how warpers were provided for, and in what stage of progress each set was.

On slashing the set, the slasher man made record of cuts and beams made on the back of card, and also the time it took to slash the set, counting time from the finishing of previous set. By this means all the slasher man's time was accounted for, the record on back of this card being cuts slashed 80½ cuts, time 12½ hours,

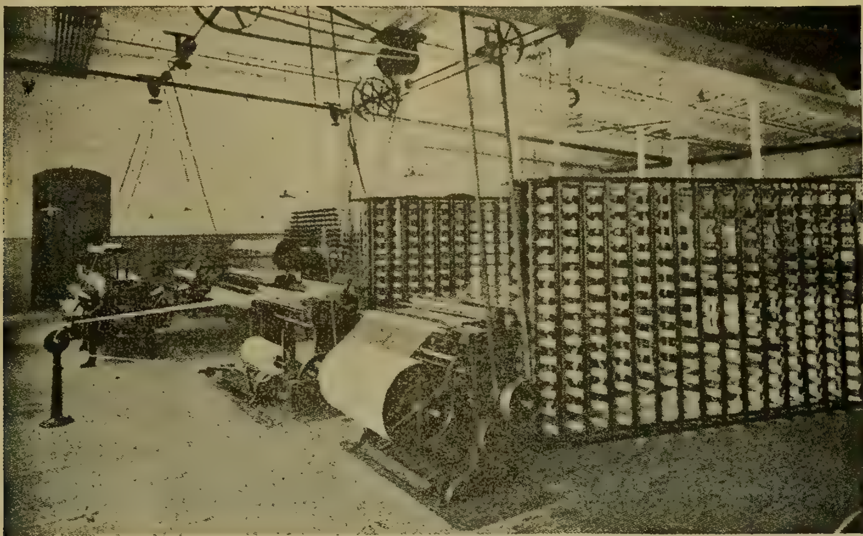


Fig. 82. Beam and Ball Warper.

After each beam was warped and tagged, it was taken to the examining frame and hung up in turn, as condition required. To avoid ambiguity, we will follow set 2035 to its finish, and then take up the other phases of the development being affected. On the left of the number set on ticket of the beam in each set, the number of the examining girl was placed by the man in charge of examining, and when the set was completed in the warping, the card was hung up on the examining nail, and when the last beam was taken off the examining frame, the ticket was assigned to a slasher number, and hung upon the pin of the slasher designated.

The loom beam on which this set was required to be put was an 82-inch Knowles, to be slashed 62 inches wide, 6 warps (4-13 and 2-14 cut). No. 4 slasher, and name of slasher man, also name of warper girl. The number (20) of warpers was marked at the top of ticket.

On completing the set, the ticket was returned to the overseer, and received date stamp and the initials of office girl who made

THE FINAL RECORD.

All yarns received in the department were checked up and reported to an office girl, who recorded the same on stock cards. In addition to our own weighing, we had the reports of the people from whom we purchased the yarn. Frequently, assignments were made for sets before the weight of a set was available, and the second hand had the option to make a tie-

over, when he found it most convenient, but never to make a beam on any other warper but the one to which the set was assigned.

This rule among several others gave splendid results, and the following list of sets will indicate these. This list was an official statement from the main office taken from regular set cards without selection.

STATEMENT IN REFERENCE TO LENGTH OF WARP CUTS, 72 YARDS EACH.

Cuts Ordered.		Cuts Made.	
	2/32-3s.		
64	Warper	64½	Slasher
76	Warper	76½	Slasher
80	Warper	80	Slash r
64	Warper	64¼	Slasher
38	Warper	38¼	Slasher
75	Warper	75	Slasher
75	Warper	74½	Slasher
75	Warper	74½	Slasher
75	Warper	74¾	Slasher
75	Warper	75¾	Slasher
75	Warper	74¼	Slasher
75	Warper	75¼	Slasher
76	Warper	75¾	Slasher
75	Warper	75	Slasher
75	Warper	74½	Slasher
76	Warper	76½	Slasher
75	Warper	74	Slasher
80	Warper	80¾	Slasher
64	Warper	64½	Slasher
70	Warper	69¼	Slasher
75	Warper	75	Slasher
75	Warper	75	Slasher
75	Warper	75	Slasher
80	Warper	79¾	Slasher
75	Warper	74½	Slasher
75	Warper	75½	Slasher
75	Warper	74¾	Slasher
75	Warper	75¾	Slasher
75	Warper	75½	Slasher
75	Warper	74¼	Slasher
75	Warper	76½	Slasher
75	Warper	76	Slasher
75	Warper	75¼	Slasher
75	Warper	75	Slasher
75	Warper	75½	Slasher
76	Warper	76½	Slasher
64	Warper	61½	Slasher
76	Warper	75¾	Slasher
76	Warper	75½	Slasher
80	Warper	79¼	Slasher
75	Warper	74¾	Slasher
75	Warper	74½	Slasher
75	Warper	75	Slasher
75	Warper	75½	Slasher
75	Warper	75	Slasher
70	Warper	70	Slasher
75	Warper	74¾	Slasher
64	Warper	63¼	Slasher
75	Warper	74	Slasher
3599		3595½	
	2/50 X R.		
75	Warper	74¾	Slasher
75	Warper	74½	Slasher
125	Warper	125½	Slasher
92	Warper	91¾	Slasher
92	Warper	92¾	Slasher
105	Warper	106¼	Slasher
75	Warper	75	Slasher
75	Warper	75	Slasher
130	Warper	129¼	Slasher
110	Warper	110¾	Slasher
75	Warper	74¼	Slasher
75	Warper	74¾	Slasher
105	Warper	105¼	Slasher
105	Warper	104½	Slasher
75	Warper	74¼	Slasher
105	Warper	104¾	Slasher
105	Warper	105¾	Slasher
75	Warper	74¾	Slasher
92	Warper	92¾	Slasher
75	Warper	74¾	Slasher
130	Warper	129¾	Slasher
105	Warper	105¼	Slasher
70	Warper	70	Slasher
75	Warper	75¼	Slasher
75	Warper	75¾	Slasher
75	Warper	74½	Slasher
65.6	Warper	66¾	Slasher
75	Warper	74¾	Slasher
92	Warper	93	Slasher
55¼	Warper	55½	Slasher
23	Warper	22¾	Slasher
14	Warper	13¾	Slasher
25	Warper	25	Slasher
59	Warper	60¼	Slasher
59	Warper	58¾	Slasher
75	Warper	75¼	Slasher
75	Warper	74½	Slasher
2988.8		2992	
	2/34 4s A.		
14	Warper	13¾	Slasher
45	Warper	44¼	Slasher
45	Warper	44½	Slasher
90	Warper	90	Slasher
90	Warper	89¼	Slasher
90	Warper	89	Slasher
374		370¾	
	2/36 4s.		
32	Warper	31¼	Slasher
	2/60 XXXX.		
70	Warper	69¾	Slasher
125	Warper	126	Slasher
125	Warper	124¾	Slasher
70	Warper	69	Slasher
20	Warper	19¼	Slasher
70	Warper	69 2-3	Slasher
61	Warper	60¾	Slasher
126	Warper	126	Slasher
72	Warper	73¼	Slasher
55	Warper	54¾	Slasher
61	Warper	61	Slasher
25	Warper	24¾	Slasher
25	Warper	24½	Slasher
52.5	Warper	53	Slasher
44	Warper	43¾	Slasher
70	Warper	70¼	Slasher
70	Warper	70¾	Slasher
40	Warper	40	Slasher
80	Warper	80	Slasher
70	Warper	71	Slasher
10	Warper	10	Slasher
1341.5		1342-1/6	
	2/34 4s.		
92	Warper	91¼	Slasher
90	Warper	89	Slasher
92	Warper	92½	Slasher
90	Warper	89½	Slasher
92	Warper	91¼	Slasher
456		453½	
	2/50 XX A.		
75	Warper	74¼	Slasher
75	Warper	74¼	Slasher
75	Warper	74	Slasher
225		222½	
	2/50 E X.		
75	Warper	74	Slasher
37	Warper	37¼	Slasher
75	Warper	75½	Slasher
187		186¾	
	2/48 X.		
20	Warper	19¾	Slasher

The first column of figures in the above list are the cuts warped in each set. The second column of figures are the cuts in each set put on the loom beams. The variations shows a loss in percentage of five one-hundredths of one per cent on the total of the whole series of sets. No. 211.

CCXII. PRODUCTION STATISTICS.

To obtain statistics as to production in detail of all machine processes and labor in cost and pounds cost, a different system or method of paying the help for service had to be established. In the slashing department, all the help were payed by the hour, excepting the warpers, who were paid by the running yard. The only production sheet was the weekly report of cuts sent to the weave room in warps and pounds in filling, and the only tally made of production and cost was at the end of each six months, when the total six months' production would be set against the pay roll. There was no data provided in detail of the several processes, such as warping, spooling, slashing and quilling.

This condition prevents the writer from giving data as to cost of each process at the time of the change of the overseers referred to. The great variety of yarns used and fabrics made precludes the possibility of even a guess as to what was the slashing, spooling, warping and quilling cost per pound.

Exceptions might be made as to warping, as warpers were payed by the running yard, but beams were made of a great variety of numbers of threads to the beam from about 250 to 540 threads in the same number. It is obvious that a beam made of a given yardage, say, 5,000 yards times 540 threads equals 2,700,000 total yards, would cost much less per pound than a beam made of 5,000 yards times 300 threads equals 1,500,000 total yards. In other words, the per cent of difference would be 2,700,000 divided by 1,500,000 equals 80 per cent. As the cost per yard would be the same in both cases, the price at 15 cents per 1,000

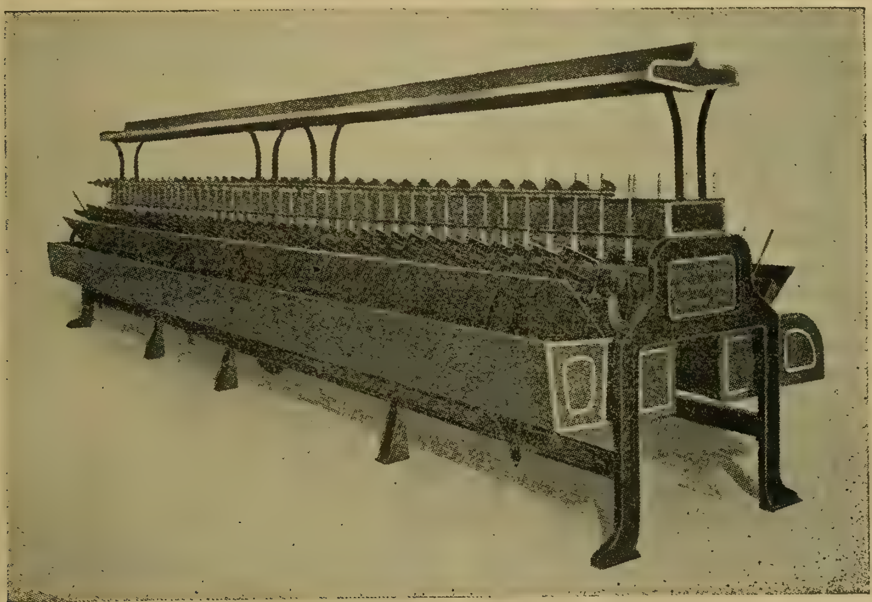


Figure 83. Spooler.

yards, 2-82 worsted, would be $.75 each beam. As beams with 540 threads will contain 301.3 pounds, the cost would be divided by $.75 equals .00249, and beam with 300 threads would weigh 167.4 pounds divided by $.75 equals .00447 pounds cost; warpers' pay roll was of no value for pounds cost data.

In scheduling price lists, spooling got first consideration, and the prices were scheduled according to the yardage of yarns on bobbins, from which the yarn was wound onto the spools. The accompanying price list will indicate the diversity of yarns to be spooled, and although not all the varied sizes of bobbins and the weight of yarn each bobbin contained is mentioned, it may easily be inferred that the most

EXACT METHOD

of estimating and compiling the list of prices was necessary, and the usual table of spindle production based on speed was of little value.

It may be explained at the outset that the best to be got from the spooler girl is the pound production of the number of bobbins she can tie up in a given period of time. As an illustration, the best spooler girls will tie up four bobbins per minute. That operation includes the putting on bobbin, bringing up the thread and tying on and incidentally taking off full spool. If bobbins of yarn contained one ounce each, the girls would wind four ounces per minute, 240 ounces per hour, 15 pounds, that is, regardless of the thickness of the yarn, whether fine or coarse numbers, but there is a condition that must be provided for, and that is, the spooler girls must have enough spindles to occupy their whole time, also an allowance has to be made for average breakage from tender places, bunches, etc. No. 212.

CCXIII. PRICE LISTS.

In this way, the following spoolers' price list was computed in the expectation that a good, smart spooler would find no difficulty in making $8 in a 58-hour week.

SPOOLERS' PRICE LIST PER 100 POUNDS.

	Spindles.	
1/30 x W mule bobbin	.40	$1.10
2/32-3s large twister bobbins	.50	.35
2/32-3s large quiller bobbins	.25	.70
1/20 cotton, large tubes	.50	.50
1/20 cotton, mule cops	.25	1.10
2/40 x W W T. 3″ spools gassed	.33	.70
1/30 cotton quiller bobbins	.50	.80
2/50 x W W T. twister bobbins	.33	.60
2/50 x R. reg. twister bobbins	.33	.70
2/60 xxxx twister bobbins	.33	.80
1/20 x W W T. gas twister bobbins	.33	.70
2/80 cotton cons	.80	.86
2/48 twisted bobbins	.40	.88

In making up price list for quilling, we had to consider that yarns were mostly delivered on five-inch spools, and the balance on spinning bobbins, also that most of the work done by the girl operators consisted in taking off the filling bobbins. The scheduling of prices was therefore done to the number, and two constants were used, of which one, when multiplied by the worsted or relative worsted number of yarn, gave the price per one pound. The constant used for yarns delivered on four-inch spools was .0057, and for yarn delivered on spinning bobbins .011. These constants were used to figure prices of yarns not previously provided for.

QUILLERS' PRICE LIST.

	Spools.	Spindles.	Per lb.
1/18 3s worsted	*	30	.02
1/22-4s worsted	5″	60	.0125
2/32-3s worsted	5″	60	.0091
2/32-4s worsted	5″	60	.0091
2/40 x worsted	5″	60	.0114
2/1/30 card	5″	40	.017
/1/50 x P			
2/1/50 cotton	5″	40	.0213
/1/50 cotton			
2/1/36 x worsted	5″	60	.017
/1/120 cotton			
2/50 x W. W. T.	5″	60	.0213
3/2/26 worsted	5″	60	.0070
/1/120 cotton			
2/80 CE. cotton	5″	60	.0342
1/24 M. L. worsted	5″	60	.0137
1/40 x worsted	5″	60	.0360
1/36 x	*	30	.0206
1/32-3s worsted	5″	60	.0352
1/16-4s worsted	5″	60	.0176
1/20 cotton mix	5″	60	.0177
2/34-4s worsted	5″	60	.0097
2/36 super	5″	60	.0103
1/20-3s worsted	5″	60	.0114
2/40 gas worsted	5″	60	.0100
2/40 x W. W. T. gas	5″	60	.0100

* Spinning bobbins.

Prices in warping to the yard, regardless of the number of threads in the tie-in running on to the beam,

WERE NOT ADAPTABLE

for obtaining correct data as to cost of warping, and the change was made to a list based on the price to the 100

pounds weight. Two constants were used to figure prices on single and on twist yarns. The price for single yarns was ascertained by using 1.50 as the multiple of the number of worsted or relative worsted yarn, and 1.25 constant for twist yarns; these constants were of general application, but we were compelled to make exceptions. For instance, any yarn 2-36s and coarser would not be warped for a lower price than 25 cents per 100 pounds and again, 2-69, 2-80 and 2-100 cotton would spool for a lower price than that one computed by the above constant.

WARPERS' PRICE LIST.

2/100 C. E. G.......5″	spools	$0.92	per 100 lbs.
2/80 x P.............5″	spools	.60	per 100 lbs.
2/58 or 2/60 cotton..5″	spools	.45	per 100 lbs.
1/20-4s ....5″	spools	.30	per 100 lbs.
2/20 cotton...........5″	spools	.25	per 100 lbs.
2/40 x grey worsted.5″	spools	.25	per 100 lbs.
2/48 x.................5″	spools	.31	per 100 lbs.
3/20 worsted........		.20	per 100 lbs.
2/32-3s grey w'rst'd.5″	spools	.25	per 100 lbs.
2/34-4s grey w'rst'd.5″	spools	.25	per 100 lbs.
1/16-4s mixture.....5″	spools	.26	per 100 lbs.
2/40 x W. W. T. rev. gas............5″	spools	.25	per 100 lbs.
2/50 x W. W. T.....5″	spools	.295	per 100 lbs.
2/60 xxxx............5″	spools	.375	per 100 lbs.
1/30 x W.............4½″	spools	.45	per 100 lbs.
1/40 xxxx............4½″	spools	.60	per 100 lbs.
2/1/36 x..............5″ 1/120 cotton.......	spools	.375	per 100 lbs.
2/1/26 worsted.......5″ 1/120 cotton.......	spools	.33	per 100 lbs.
1/20 mix. cotton....5″	spools	.38	per 100 lbs.
1/30 grey cotton....5″	spools	.45	per 100 lbs.
2/40 grey cotton....5″	spools	.38	per 100 lbs.
2/26 mix. cotton.....5″	spools	.45	per 100 lbs.
2/50 reg. worsted....5″	spools	.31	per 100 lbs.
2/36 prime or super.5″	spools	.25	per 100 lbs.
2/80 cotton...........5″	spools	.60	per 100 lbs.
1/50 x P.............5″	spools	.75	per 100 lbs.
2/1/30 card...........5″ 1/50 x P..........	spools	.35	per 100 lbs.
1/20 x W. W. T. gas ....5″	spools	.30	per 100 lbs.
2/1/28 ....5″ 1/120	spools	.31	per 100 lbs.

In all

NEW YARNS

not provided for, a price was not set until sufficient tests had been made to prove whether the above constants would figure the correct price or not, but in all cases, and in all price lists, care was taken that when a price was made, no change should be necessary.

To insist on this feature in this mill was very important, as the practice up to date was to make allowance for all sorts of seeming abnormal conditions, thus giving a poor standard for this department. The prevailing idea was that if any piece worker did not get through enough work to give them fair average pay as per schedule of prices, they should get any allowance to make up the difference. This was one of the hardest problems which the new man had to solve. This was minimized to almost its elimination by pursuing the above policy. On the adoption of these schedules, there were some incipient strikers, but none of any weight, and none that produced any change in the schedule of prices.

In the administration of the department, the interest of the help was always kept in mind. In the case of warping, the beams for a slasher set were warped to the largest number of threads possible. This enabled the warpers to get off a large poundweight in the making of each beam.

Every facility was provided to enable the operator of any of the machines to attain the highest pound weight of production, and as the rating was done with care and with due consideration of all conditions, the help soon learned to know that their best efforts would receive just recompense, and this created a contented feeling throughout the department.

No. 213.

CCXIV. TAKING OUT IMPERFECTIONS.

The yarns bought in the open market were found frequently to contain bunches, etc. As a matter of economy, these imperfections were taken out in the dressing room, as it was realized that the taking out of a bunch when woven into the cloth was very expensive, and did harm to the appearance of the cloth, while to take a bunch out in the dressing process, costs comparatively little, and, of course, the cloth was in no way impaired.

Up to this time, most all warps slashed, particularly warps for panamas, were examined by men running them from loom beams to loom beams, these men taking out all imperfect yarns, bunches, etc. This did not give the best results, as the warps were too dense, that is,

had too many threads for these men to see every imperfection, and the cost of the work was very high, about two cents per pound.

Also when an imperfect thread was tied out, two knots were put in the warp, as each piece of yarn tied out had to be replaced. To meet this problem, a frame, (see Figure 84), was rigged up to take section beams, and girls at not more than 14 cents per hour were employed to take out the imperfections. This proved highly satisfactory, and machines carefully designed and made to meet the conditions were installed,

A is the section beam from which the yarn is taken and wound onto B section beam. Gudgeons of beam A rest on bearing that can be wound out by a screw device C. This device provides adjustment for the two beams. Beam A is placed in the frame by a chain block and trolley. This is necessary, as the beams are usually full of yarns, weighing sometimes over 500 pounds. The gudgeon of Beam B is placed in the hollow gear shaft, and the head of beam is engaged by stud (which is omitted in the sketch) of dog, J, on gear shaft.

This beam is supported on the op-

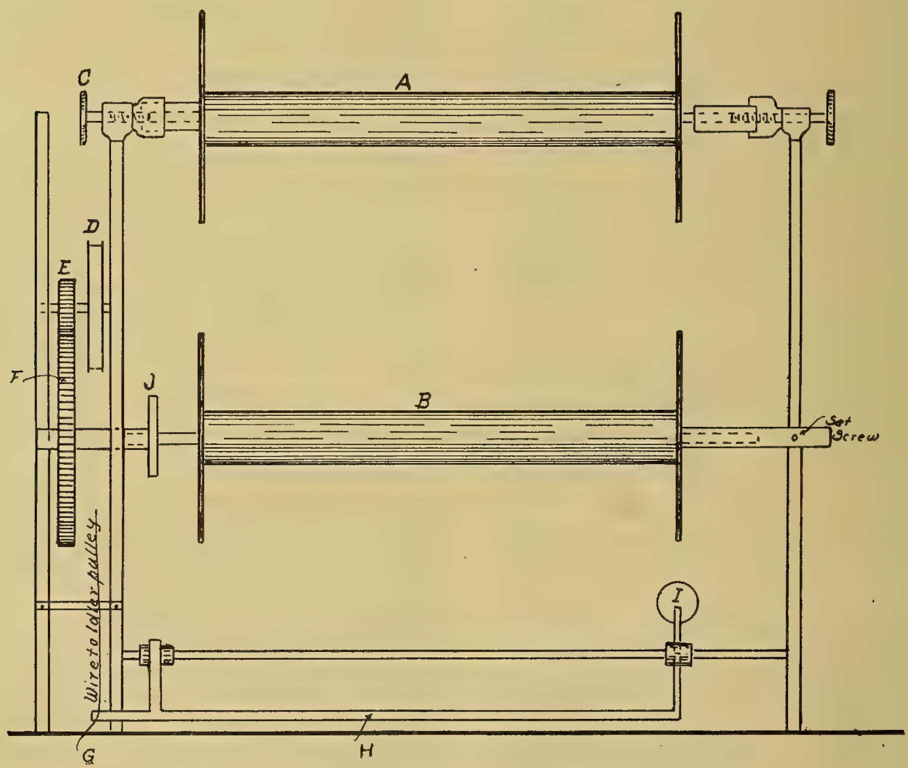


Fig. 84. Examining Frame.

and a system of checking production was followed up, which prevented carelessness, and gave excellent results.

EXAMINING FRAMES.

This sketch of examining frames shows the particulars of arrangements.

posite side with a hollow shaft in which the gudgeon enters. This shaft rests in a bearing attached to the frame, and is held in position with a thumb screw. In putting in the beam, this shaft is pushed clean up to the beam holding it up against the dog

by which the beam is driven. D is a flange pulley, which is driven by a slack belt. An idler pulley (which is not shown in sketch), engages belt at the underside of pulley. The lever holding the idler works free on its centre at which it is supported by a stud attached to the frame of the machine. Attached to the opposite side of the lever is a rod G, which is fastened to shipper H, by which the operator controls the drive of the machine.

An adjustable weight, I, can be moved backward and forward on the lever on which it rests, to balance the shipper. By pressing the foot board, H, the idler pulley takes up slack of belt, and starts the machine. There are put in the grooves of the heads of beam A ropes, weighted to provide friction. The operator stands in front, and when taking out an imperfection, breaks back on the top beam, taking the length of one round of beam to tie out imperfection. This was done by the tying of one knot. By breaking back on the top beam, the finished bottom beam had a uniform yardage of each thread throughout its whole length.

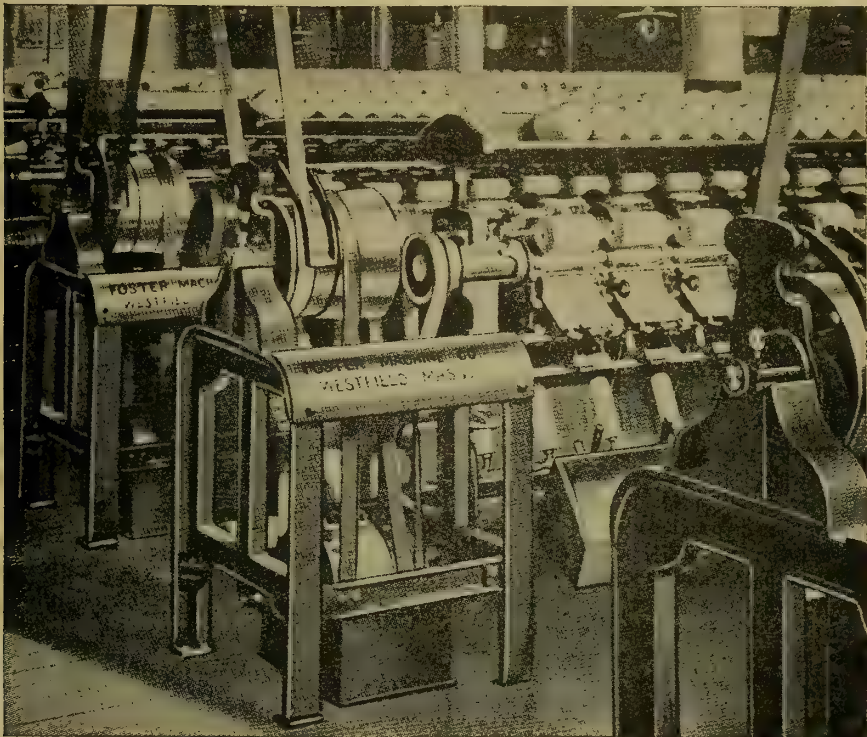


Fig. 85. Foster Winders.

The checking method was done as follows: From the time of finishing one beam to the time of finishing the next beam was credited to the operator, pounds yarn on beam, and time taken in examining beam. Imperfections taken out were weighed on grain scales, and percentage of imperfections to pounds examined figured. A rule was laid down to the office girl, who took care of this data to report to the overseer when the number of pounds examined per hour was abnormally low, and grains weight of im-

perfections were also low. In other words, a girl running low in pounds per hour would show reasons in the large quantity of imperfections she has had to take out, otherwise, she was negligent of her work, and disciplined accordingly, record being made of all this matter. No. 214.

CCXV. TUBE WINDING.

At this stage, it would be well to explain the introduction of Foster winders into this department, and the experience that was had in scheduling prices. It was frequently found that in buying yarns in the open market, what was wanted could only be obtained on tubes. These had not been successfully handled in the warper heretofore, and the practice was to rewind them on to spools, and warp from spools, but a large lot of yarn on tubes was secured with a light twist, and it was found by rewinding it became

TOO TENDER TO WARP.

A series of experiments were made to see if there could be a readjustment on the warper to make it possible to warp direct from the tubes These experiments were successful, and it was found by rearranging the top and bottom of creel a free and even tension delivery from each tube when in the creel could be obtained. This was accomplished by bringing each end of the skewer into correct relationship, equidistant with the point around which the thread bent as it ran to the warper.

This success was so important that practically all the warper creels were changed over, and several Foster winders were installed on which to wind the yarn, instead of spooling it In considering the method of scheduling prices, it seemed from the conditions under which the operator worked that there need not be any difference in the rating, but in starting up these machines, the operators objected to the spooler's schedule of prices, and after a try, the matter was referred to the superintendent, who suggested a better price list in accordance with the first try.

The overseer contended that it would be a mistake to do so. The matter was referred to the maker of the machine, the seller and the fitter, and they all agreed that it was not to be expected that winding could be done as cheap as spooling, and that handling the yarns in the package was of so much benefit that the use of a winder was a decided advantage. These high opinions had no effect in convincing the overseer, and the superintendent agreed that for the present, at least, an allowance be made to each operator who had worked faithfully, but who did not get as much money as she would have earned had she spent her time in spooling.

This was left to the overseer's discretion, and the outcome was that the same girls averaging some $8 per week on spooling, earned by winding wages as high as $11, and some even more.

Under the circumstances, it was not thought wise to schedule a separate

WINDER PRICE LIST,

but data was obtained to compute prices for work done. This data showed that one price would serve for all numbers, when the weight of yarns

were the same on all bobbins from which they were wound. For instance, cotton mule cops contained about two ounces of yarn, and frame bobbins about one and one-half ounces. If a girl had the proper allotment of spindles to the number of yarn, she would wind the same pounds per day or week of any number. The following table will show the allotment to the number, and 100 per cent production of each spindle less one spindle to the allotment.

POUND PRODUCTION VALUE OF EACH WINDER SPINDLE RELATIVE TO WEIGHT OF YARN ON COP TO THE NUMBER OF OUNCES, ALSO YARDS.

No. cotton yarns.	Weight. Ounces.	Mule cop. Yards.	Spindles.	Lbs. per spindle per 58 hr. wk.	Lbs. per operator 58 hr. wk.
10	2	1,050	28	62	1,674
12	2	1,260	33	52	1,664
14	2	1,470	39	44	1,672
16	2	1,680	43	40	1,680
17	2	1,885	46	37	1,665
18	2	1,990	50	35	1,700
20	2	2,100	56	31	1,705
21	2	2,205	59	29	1,682
22	2	2,310	62	28	1,708
24	2	2,520	67	26	1,716
26	2	2,730	72	24	1,704
28	2	2,940	78	22	1,694
		Ring frame bobbin.			
30	1½	2,360	63	20.7	1,283
34	1½	2,677	71	18.3	1,281
36	1½	2,835	75	17.3	1,280
38	1½	2,992	79	16.3	1,271
40	1½	3,150	84	15.6	1,294
45	1½	3,545	94	13.8	1,283
50	1½	3,937	110	12.42	1,291
55	1½	4,331	115	11.33	1,289

The above table is estimated on a winder speed of 150 yards per minute, with the

REASONABLE ASSUMPTION

that a girl can tie up a thread in 15 seconds on an average, that is, four threads per minute, the table being figured out as follows: Two ounces of No. 10 cotton contains 1,050 yards divided by 150 yards per minute as a divisor, would give quotient 7. This figure is the number of minutes it will take to run off a cop containing two ounces of number 10s yarn. The number of spindles a girl will be able to take care of will be, therefore, 4 times 7 equals 28. As in the operation there will be always one spindle stopped, the production of each operator or girl will be one spindle less than the allotted spindles; therefore, 28 spindles assigned will give a production of 27 spindles, and in all cases, each spindle assignment will give a one-spindle less production.

Pounds per spindle, figured with a constant of 52,200 as a sum to be divided by the yards per pound to the number, and this constant being yards production of a week of 58 hours, it is obtained as follows: 150 yards per minute; 900 yards per hour times 58 equals 52,200 yards.

The last column of above table shows the maximum production for a 58-hour week of one operator on each number specified, and as these figures are obtained by

CORRECT DEDUCTIONS,

it may easily be seen that a price per number is not essential, in fact, it is an incorrect way of paying for winding. This may also be said of spooling, but to give the operator a chance to make wages, spindles will have to be allotted according to the yards on bobbins from which the yarn is wound. The percentage of variation in the list of pounds per week is only 3 per cent on the two-ounce cops, and not quite 2 per cent on the 1½-ounce frame bobbin.

The writer is aware that it is practically impossible to get a 100 per cent production, but in the above table, every reasonable consideration has been met, and there only remains the condition of the yarn as a factor to effect the above conclusions. As yarn breaks so many times on an average, the number of spindles allotted to the operator should be reduced proportionately, and the production payed for in accordance with the spindles operated. No. 215.

CCXVI. SLASHING ROOM LABOR REPORT.

Concurrent with the establishing of the changes mentioned, the dressing room office was organized to take care of the reports of production of machines and processes, and in addition to the pay roll, a labor report,

was made out each week. A printed form was used to fill in labor report in detail of counts of yarn and stock, and under each process, spooling, warping, examining, slashing, quilling, pounds production to the number, total cost and cost per pound, also pounds waste and waste percentage to pounds production of each process. Separate, but under the same heading, charges for room help were recorded, spooler helper, warper helper and charge for spooling pieces. This item was charged to the warping, as the yarn was bought from outside, and the spools had to be emptied and returned to the maker of the yarn, also examining helpers and spare girls.

The frequency of overtime in this part of the department required that we should have a separate record, as the extra cost of overtime to the pounds examined weakened the data, and made it less reliable. Slashing extras for overtime were recorded separate to make data more exact. Resizing indicates how much work was returned from the weave room, helpers, etc., quilling, helper and bobbin boy. A

SUMMARY OF ALL PROCESSES

was made covering pounds production, total cost and total pounds cost, waste and waste percentage in each kind of yarn and under each process. There was also the room overhead charges, second hand yarn man, scrubber, and clerk. A copy of this report was sent to the main office, and original report retained in the dressing room office, and it was expected that all moneys charged up on the pay roll would be accounted for. All extras allowed piece workers, and all other charges for bad work were charged up to the department or mill responsible. The strongest agency that an overseer can use in controlling those working under him is the impression that he is fair and just, and that he is familiar with all the conditions of the work which they perform.

This is to be best obtained by having data to show comparative conditions. For instance, if any of the help is not giving sufficient pounds production, and it is found necessary to call attention to this fact, if approached in general terms, the help will most assuredly say they are doing as much as their associates, and, too, that they work much harder than most of the others. Unless you have data, the culprit will take on an aggrieved air, and nothing more than a

CONDITION OF IRRITATION

will be effected.

On the other hand, if approached with a comparative statement taken from the records and the data there set forth, there is nothing to be said, and a gentle appeal to their personal pride will do much to bring them up to an effort equally as efficient as their associates; not only this, but in the first case, the help will think they are doing enough, or if they know better, they will feel that they have been successful in hoodwinking the boss. In the latter case, on the contrary, they will realize that nothing but facts will go, and that the boss knows his ground.

From the data found in this labor report, compared with previous reports, the overseer obtains

A CORRECT UNDERSTANDING

of all the detail of the essentials in his department, and therein finds encouragement by improvements noted, and also his attention is directed to defective conditions needing corrections

The defects of the slashing process were in the excess of waste made, and the irregularity of lengths in cuts and warps, also too many warps were brought back from the weave room that were improperly sized. No. 216.

CCXVII. CUTTING DOWN WASTE PERCENTAGE.

The excess of waste was made from various causes, but resulted in all cases in sets of section beams running out uneven. To remedy this, the slasher man was requested to be careful as to how he put his friction rope on the section beam heads, which rope should be hitched to the cross bar of

the section beam stand, and brought around the head of the beam in the direction in which it ran, this on all beams. Gear clocks were put on warper and instructions given that no changes be made in the gearing, only by one particular man, and also a rule laid down that each beam in each set be made on the same warper. With these provisions made, the waste problem was brought to a very low percentage—as low as .004 per cent.

IRREGULARITY OF LENGTHS

in cuts and warps complained of by the weaver were not entirely chargable to the dressing room. It too frequently happened that the weavers in their anxiety to get another cut in their week's pay would take off their cuts before cut marks were woven up, and the complaint as to lengths was not sustained by evidence of marks on the short cuts. In the piece, this may not have meant anything, but it is the only evidence that will satisfy a slasher man. The number of cuts to the set was uniform. This was convincing that the trouble might be in the slasher.

A thorough investigation of the measuring mechanism was made. The slashers were Lowell machines with hot air drying chambers. The measuring roll was on the front head, located just beyond the dividing rods. The marker was at the back of the hot air chamber, and in front of the size box. To operate the marker, a small shaft made the connection between the marker and measuring roll.

In the operation of this mechanism, many bevel gears were used. These gears were cast gears, and each set required plenty of play to work safely, but the aggregate of play at the marker was so great that the finger that brought up the marker could be moved freely some 30 degrees.

This condition suggested that the

PROBABILITY OF ERROR

on the release of the marker was very great. To effect a remedy by eliminating the series of bevel gears, the measuring roll was put at the back of the slasher, replacing the bottom carrying roll, and a casting was made to carry the measuring mechanism, eliminating the series of bevels. This proved so satisfactory that all the slashers were fitted likewise, and by this method the accurate measure to cuts and warps was obtained. This did not entirely satisfy the weaver, but as before stated, the errors of lengths were not all chargeable to the slasher.

The following size formula will illustrate what the new man had to deal with.

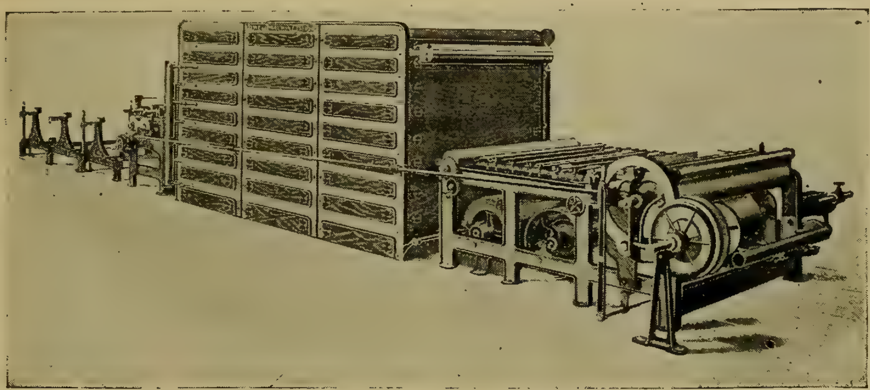


Fig. 87. Hot Air Slasher.

SIZE FORMULA FOR QUALITY 5138.

1/40 x C.
12 inches water finishing 17 inches, 138 gallons.
50 pounds starch.
50 pounds P. gum.
85 pounds No. 3 glue.
2 quarts glycerine.
4 pounds tallow.
Compound.
3 ounces borax.
3 ounces sulphate zinc.
6 ounces salt.
1 ounce sal ammoniac.
2½ ounces crystal magnesia.

One batch and a half of this size, 207 gallons, sized a set of 46 cuts of 60 yards, 437 pounds.

This formula was

AN OFFICIAL ORDER,

and until it was tried out, the new man did not wish to be antagonistic, but as its real value became apparent, he asked to have it referred to the chemist, who reported that there were ingredients in this formula for which he could not find any necessity.

This formula with many others was discarded. These various formulas were intended for the different kinds of yarn we used, and because of the variety of goods made, it was difficult to keep the slashers supplied, and the following formula was adopted, which, by diluting, could be used for all kinds of yarns:

SIZE FORMULA.

	Single worsted.	2/32.	2/60.	Single cotton.
Water, gallons....	10	15	17.5	20
Starch, pounds....	5	5	5	5
T. gum, pounds...	5	5	5	5
Tallow, pounds....	0.5	0.5	0.5	0.5
Glycerines, pints..	0.25			
Tragasol, pounds.	2.5			

Neutralizer. Acetate of sodium, 5 pounds per 100 gallons of size for blacks.
Anticeptic. Sulphate of zinc, 8% pounds of agent.

This size formula gives the proportion under four distinct headings. These headings represent all the different grades of goods made, each containing a variety of different numbers and kinds of yarn, and with the exception of the single worsted, the same ingredients were used, but with a difference in the gallons of water.

No. 217.

CCXVIII. CONDITIONS IN EVIDENCE.

With these reports, the conditions in the department in its various activities were in evidence, and the matter needing prompt attention was the waste question. Neither second hands nor section hands had the faintest idea of yarn values, and their idea of the requirements of their position was to keep the help at work, and if a girl made waste extravagantly, they would probably give her a call down, but if conditions of the yarns were bad, the making of waste to excess was considered as confirmatory evidence that the yarns were really bad, and the question of economy in the making of waste was forgotten.

THE REMEDY

adopted to effect a cure for these conditions was successful in results.

The overseer took up the matter with each man responsible for the waste made by calling their attention to the value of yarns used in the department, and asked them to hereafter keep a little note book, and make a record of the pounds waste taken from these weekly reports, and call on the office girl who had charge of the production sheet for total pounds of yarn, for instance, quilling, during the same week. The overseer showed each of the men how to figure percentage, called their attention to the relations of waste to pounds produced, and incidentally suggested to these men that to get accustomed to an understanding of percentages tended to fit them for better positions.

IMPROVEMENT EFFECTED.

In following up this arrangement, it soon became apparent that an improvement was being effected, and the men with this better understanding were saving the company money, the overseer co-operating with them, showing each of them the value of their savings in dollars, also telling each man that his effort would be credited to him in the report to the superintendent, and in some cases, the savings effected exceeded the man's wages.

It is a strange commentary on the ordinary operator's thoughtlessness to see them stand and pull off yarn from a spool continually for some minutes to avoid tying up the same thread

once, which could be done in fifteen seconds or less. The value of waste economy, as men realized it, also brought the fruits of a larger production and more wages to the operator, as the time spent in making waste was employed in getting production.

Production from warper was affected unfavorably by the variableness of the yardage on each spool coming from the different yarn mills from whom yarn was bought. As each spool received had to be returned empty, the warping had to be done as near the bottom of spools as possible, and when making out the set card, the overseer had to keep this in mind. A record was kept of yardage on the different spools, and the rule was established that in all yarns received from a new yarn maker on the first tie-over, the set would be run until some five or six spools of the set were run off.

THIS TEST

would determine length of all sets in the future made of each maker's yarn. The rewinding of pieces was made chargeable to the warping as a separate specified item, as the only proper place. By careful checking off of averages, it was found that of all the yarn received 10 per cent of it would be rewound at a cost of two cents per pound. This statement needs an explanation.

It was not only the pieces that were brought back from the warper after a run-out of a regular tie-up, but the spools of the rewound pieces would come back time after time to be rewound until cleaned up. No. 218.

CCXIX. DIFFICULTIES TO BE MET.

It would be proper and in order at this point to describe some of the difficulties that the new man had to meet in his efforts to secure best results, and over which he had no control.

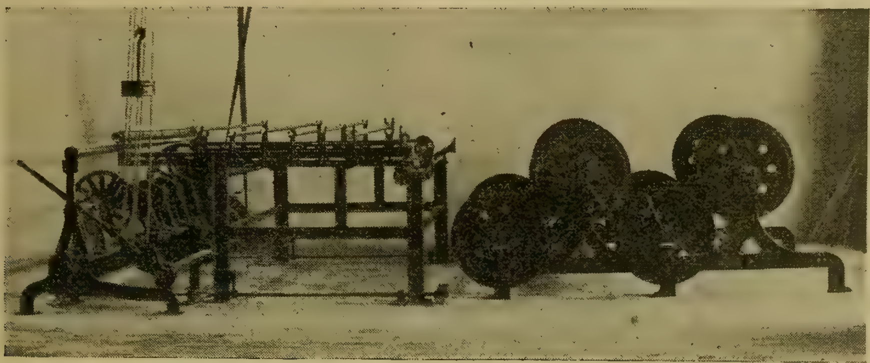


Fig. 88 is a dry slasher referred to in a previous chapter. This is used in mills where the goods manufactured do not need size to aid in the weaving.

On a rearrangement of the dressing department, it was found expedient to order two new size kettles. The matter was taken up with the chief engineer who sent his assistant to the overseer of the dressing department, and the whole matter of the amount of size needed each day and the various sizing solutions used, etc., were gone into fully.

At that time, there were four wet slashers, each of which took nearly 150 gallons of size each day, in all 600 gallons. There were four formulas of sizing solutions which were all distinctly different, all of these being used from day to day. This information was taken down by the assistant engineer, and this matter, as far as the

dressing room was concerned, was allowed to rest.

In the course of time there was delivered to the department what seemed to be a boiler. On inquiring at the main office the information was received that this was the first size kettle of the two ordered. Further inquiry elicited the information that as the slashers needed 600 gallons each day the corporation was getting two kettles with 600 gallons capacity. The kettles ordered were to have jackets, but on examining this monster, the only part that was jacketed was the base.

ALL SORTS OF OBJECTIONS

were made to the installation of this kettle, but the management insisted on trying it out, and it was set up, but the only way the size could be cooked was with an open pipe delivering steam inside the solution. To remedy these defects, the second boiler or kettle was ordered to be made with jackets extending up all sides of the boiler or kettle, and it was shipped in under protest, but the assurance of the management was given that this kettle would do the work. In the meantime, No. 1 kettle had been returned to the maker.

After piping up this second kettle, every effort was made to cook size, but even water could not be brought to a boil. An expert was sent to make tests, and after 1¾ hours' effort, the expert claimed he had brought the water to a boil.

This test, however, demonstrated that this expensive tank was entirely unsuitable. This decision was not made until after No. 1 kettle also jacketed all the way up the sides had been returned.

At this point, the management consented to buy kettles from a maker with a 150-gallon capacity. The cost of these two kettles was over $1,000 each, $2,000 in all, in addition to the losses entailed in the department through experimental work. No. 219.

CCXX. DECEPTIVE CONDITIONS.

Warps were called for a quality, the samples of which were made from a few pounds of yarn taken from a lot being spun for a yarn customer. The yarn was 1-30 worsted and contained 18 turns twist. The warps were made from yarns presumedly the same as sample, and were sent forward to weave room and put in looms. After starting up these warps, it was found that they did not weave well. The dresser was taken to task, but had no explanation to offer.

INQUIRIES MADE.

Inquiry was made, and it was ascertained that the above yarn customer who received his yarns in the form of slashed warps found his warps wove all right. Set after set was made for looms, but these warps would not weave well. After a while a hurried order for warps from the above yarn customer was received, and as the order was wanted in a hurry, a set was made from the yarns in the dressing room that were understood to be of the same number, quality and twist. On the set being finished and sent out to be shipped, advice was received from the main office that these warps would not do, as the lot of yarn intended for this customer had not been made.

Inquiry was made to ascertain what was the difference in the yarn and the reply was that it required 18 turns of twist, whereas the yarn used in the warps sent to the weave room only contained 16 turns. In other wards, the samples produced in which this yarn was used had two turns more than the yarn put into the straight goods. This change of twist was made without any advice from the superintendent who was unaware of it until the above inquiry was made.

This explained the difficulty in weaving the warps of the above quality, but this was only an incident. The management worked continually with expedients and recognized no rules, and there was no explanation given for changing the twist.

Yarns were coming in 1-40 worsted, which was made up into warps that wove badly. The understanding was that the yarn was

French spun, and it was received on five-inch spools.

THE DIFFICULTY IN WEAVING

these yarns caused an inquiry into the matter, and it was found that instead of being mule-spun, the yarn was frame-spun, and instead of the yarn being made in the French system, the whole process of making this yarn was Bradford system.

To make it plain to the reader, it should be said that in the Bradford system oil is used in the stock to a very large extent to aid in the processes of drawing and spinning, and as this oil is very much in excess of the amount of grease used as a softener in size, the sizing ingredients would not stay on the yarn, but would work off in the loom, and the warp yarn would chafe and ball up and break in the weaving.

The French system does not need the assistance of oil, etc., to assist in making the yarn, therefore, the size would stick to the yarn and the warps would weave. No. 220.

CCXXI. OVERSEER KNOWS BEST.

Preparatory to the installation of examining frames, a lot of experiments were made and exact conclusions arrived at. The design was worked out and every condition was taken cognition of, and a complete understanding was established as to every detail of the machine and an order was made out for the necessary castings, pulleys, etc.

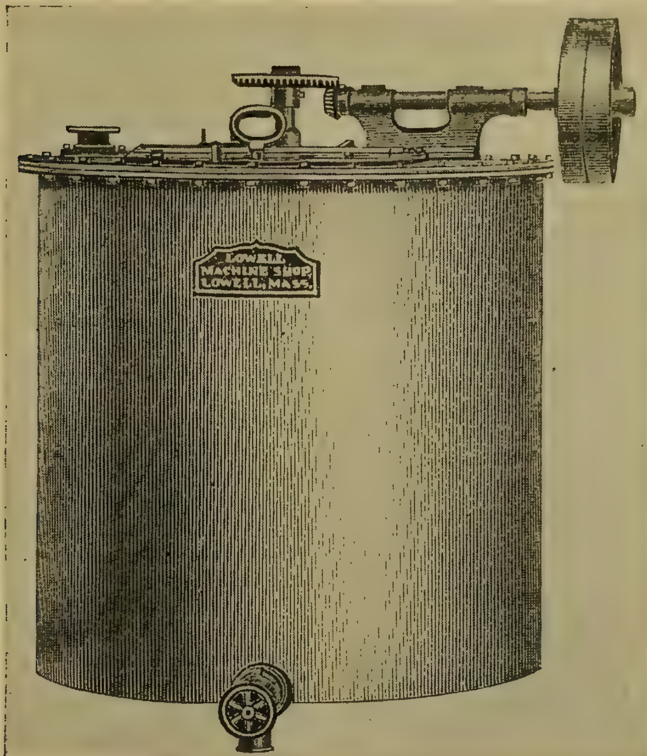


Fig. 89. Size Tank.

On receipt of the first set of four machines, which were set up according to plans in the room, it was found that there had been what seemed to be

a mistake made in the designing of the casting. By way of explanation (See Figure 84, issue of November 16), the drive was a slack belt controlled by an idler pulley attached to a foot lever. By the pressure of the foot of the operator, the idler would take up the slack of the belt and the machine would run at a speed according to the pressure used.

This

IDLER PULLEY

was planned to be placed where it could take up the slack belt at the back of the lower side of the pulley. The machines being belted to be driven from the top side of pulley, the mistake was made by a change in the casting which brought the idler to the top of pulley and caused it to rest on top or tight side of belt.

Complaints were immediately made, but the machines continued to come in until there were some 40 out of 44 machines received all wrong. During the time the machines were being delivered, the management was receiving complaints daily, and the only reply to these complaints was that the principles involved were not understood. All the operators were women, and the strength required was too much for them and help could not be retained.

The outcome of it all was, the overseer found a way to hang his idler to engage the bottom belt, and matters became serene. But who ever heard of a slack belt driven with the idler pulley on the take-up side of the belt instead of the slack side. No. 221.

CCXXII. HAND DRESSING DEPARTMENT.

During the evolution in the slashing room, which has been described in previous chapters, a good deal of consideration was given by the new overseer to the hand dressing department. The difficulties he met there were of an entirely different character than in the slashing room, and to some extent this department was even more deficient in organization, and instead of scheduling wages to obtain data as to costs, etc., the prime consideration was the keeping down of expenses in preparing the yarn and chain warps to enable the hand dresser to do his

WORK ECONOMICALLY.

At the time the new man took over this charge, all chain warps required were made outside of his department. The method in vogue in directing the supply of grey warps was productive of some very expensive complications. The way the dyer was provided with warps to fill the dyeing orders from the dressing room made it impossible to keep a correct tally on available warps at the dyehouse. The practice that was prevalent in the dressing room in directing the dyer as to what warps were needed from day to day was the cause of the accumulation of surplus warps in the color for which there were no orders.

By explaining the procedure that was observed on receipt of an order from the main office, the reader will more readily understand the difficulties that confronted the new man in his effort to direct the work of this department. The difficulties consisted principally in the making of careless and inaccurate records on the stock book on receipt of grey warps and neglecting to check off warps assigned to specified orders, which was a free and easy way of forwarding warps to the dyehouse rather than have them put in stock, thus again entailing labor when wanted in the dyehouse.

USUAL PROCEDURE.

All orders for warps for the looms that were required to be hand dressed were entered in a book kept for that purpose, and the office girl, in accordance with the information contained in these orders, would make out loom warp tickets and hang them on pins in a board provided for that purpose. On completion of the dressing of a warp, the second hand would issue to the dresser a ticket taken from this board, that is, after a record was made to his credit on dresser's book of particulars which determined the value of the labor performed in the dressing of this warp. This ticket the dresser would fasten to the lease strings of his warp and

it was ready to be sent to the weave room.

On receipt of an order for hand-dressed warps, the overseer would make out an order on the dyehouse on a form which gave the following particulars: dyehouse order, number, date, number of warps, shade, number and grade of yarn, threads in warp, length in yards, pounds weight of each chain warp, also the name of the company which would supply the warps. A copy of this order would be sent to the dyehouse and the original retained in dressing room to check warps off as they were received from the dyehouse after having been passed as to

SHADE AND CONDITION.

The orders for qualities made out by the assistant superintendent contained the information as to the number of chain warps wanted and of whom they were ordered, also the number of warps in stock that could be used (if any). In this order, unfortunately, the stock warp lists from which the assignment was made were very inaccurate, and frequently there was a shortage of warps and a tie-up of the order. This inaccuracy in the stock sheet was caused by the method by which warps were checked when received from the yarn mill. In theory it was expected that all warps ordered outside would be required to go to the dyehouse, and the shipper would send all forward as they came in.

In practice, although every provision had been made to secure chain warps by ordering them forward, sometimes before the yarn mills had made their first shipment the customers ordering the goods would be calling for deliveries, and stock warps of the right number and grade of yarn, but ill suited for this quality, would be prepared in the grey for the dyehouse, and sets to the shades colored; not only by taking warps would the list be changed, but as mentioned above, all warps would be sent to the dyehouse as they were received, and the ones that were replaced would also go to the dyehouse and remain there in stock with no accounting made for their presence.

Warps made in the cotton mill of this company for the dressing department were made from yarns bought outside by the cloth department. This yarn was delivered, too, on a verbal call order from the room in which these warps were warped and prepared, and a case or cases were sent along without any attempt being made to determine the pounds required to fill orders and pounds sent up. In other words, there was no checking made to show whether pounds warps came back to the dressing room equivalent to pounds yarn sent up.

All warps and yarns colored in the dyehouse were charged up to the cloth department for payment, so much per pound. These charges were made once each month. There was no tally sheet kept in the dressing room outside of the dyer's slip. Errors in charges were very likely to be made and would go unchallenged. Because of conditions in the dyehouse there were very many warps sent back each day off shade, ended, hard-sized, tendered, etc. The probability of these warps being charged for more than once was very great, due to the manner in which orders were handled. No. 222.

CCXXIII. SELECTION OF DYESTUFF.

In this mill, the procedure they observed with reference to the purchasing of dyestuffs was unusual, and illustrates the difficulties that confront the faithful overseer.

An order for four warps to be colored a blue slate was put into the dyeing machine. The solution used was prepared according to formula used in coloring the sample.

As the coloring proceeded, it was evident that the shade was not right, for the warps came from the dry cans so far off shade that there was nothing to be done but to put these warps into blacks, and a second set was put into the machines after the solution was prepared by the dyer. This preparation was usually the work of the second hand, but to make sure there was no mistake being made, the overseer gave it his full personal at-

tention. This second set at the dry cans was no better, so the dyer carefully scrutinized his records, and called for new samples from the dressing room to be taken from the sample warp which it was intended to duplicate. He found no difference in his standards and the samples he called for. In his perplexity he called for another set of greys, as he felt sure that he could repeat his former shade, but after coloring his third set, the results were no nearer the shade.

At this point,

A SAMPLE OF DYESTUFF

was sent to the chemist, who, after looking up his records, reported that the dyestuff used was bought from a different dyestuff company, as the cost per pound was lower. In this whole matter the dyer was not consulted nor informed of this change, nor did the chemist make any test to prove this cheap stuff a correct substitute. It was also learned that as a rule no tests were made by the chemist on any material until trouble developed. They had a high-priced chemist and a very complete laboratory, conditions which are usually established to prevent trouble by testing all chemicals coming into the mill, but in this mill only to locate trouble after it appears, and we presume to establish a claim for compensation, was the extent of what was required of the chemist.

Up to this time, the

METHOD OF CHECKING WARPS

for shade was unique. There were no standards kept. Shades were first selected in the designing room, and to these shades short sample warps were colored. The regular orders being provided for, a cutting from the sample warp would be sent to the dyehouse on the number of the shade determined by the designing room. On the warps of the color being received from the dyehouse, as was the practice, the overseer would match them for shade to sample and shade to ends, feel for size and a general examination for condition of warps as to usage received in the dyehouse, broken, tangled up, matted, tendered, etc.

The unique feature referred to was that on the second set being received, a cutting from the first set would probably be used to check the shades, and when the third set came along, a cutting from the second set. The effects of this procedure can easily be conjectured, and as an illustration, on receipt of a set of warps from the dyehouse, the second hand, as was usual, brought the sample shades to the trucks containing the warps. The new overseer, finding the warps off shade, was about to order their return to the dyehouse when the second hand suggested that he look over his shades to see if he had not made a mistake. The overseer accompanied him and found that the sample shades which were in the custody of the second hand were of divers kinds and shades to

THE SAME SHADE NUMBER.

Being left alone, the second hand selected a sample he thought would match the warps, and was about to proceed to check for shade, but the overseer wanted an explanation, and was informed that all shades were subject to modification from season to season, and that this particular tan shade was required to be kept on the yellow side—the yellow side of what? The second hand was nonplussed, but the overseer found an explanation for the shades varying so much in the pieces No. 223.

CCXXIV. SAMPLE COLORS TO A FIXED STANDARD.

Recognizing the impossibility of uniformity of shades under these conditions, a system of standards was adopted. Provision was then made that all new shades thereafter should be standardized by the designing room. On the first coloring for samples a half pound of yarn would be added to the required weight and when passed as correct to shade this half pound of yarn would be retained as a standard and be properly marked and classed.

On receipt of orders for regular goods, taking a particular new color, two cuttings of about three ounces of yarn each would be taken from the

designing room standard of this color and one sent to the dyehouse and one to the dressing room, the balance being retained in the designing room. Any modification in shade would call for the return to the designing room which was marked also with the same number. This sample was used in all matching until it began to show loss of color, and was then replaced by another piece from the cutting referred to. This latter was put away in a dark

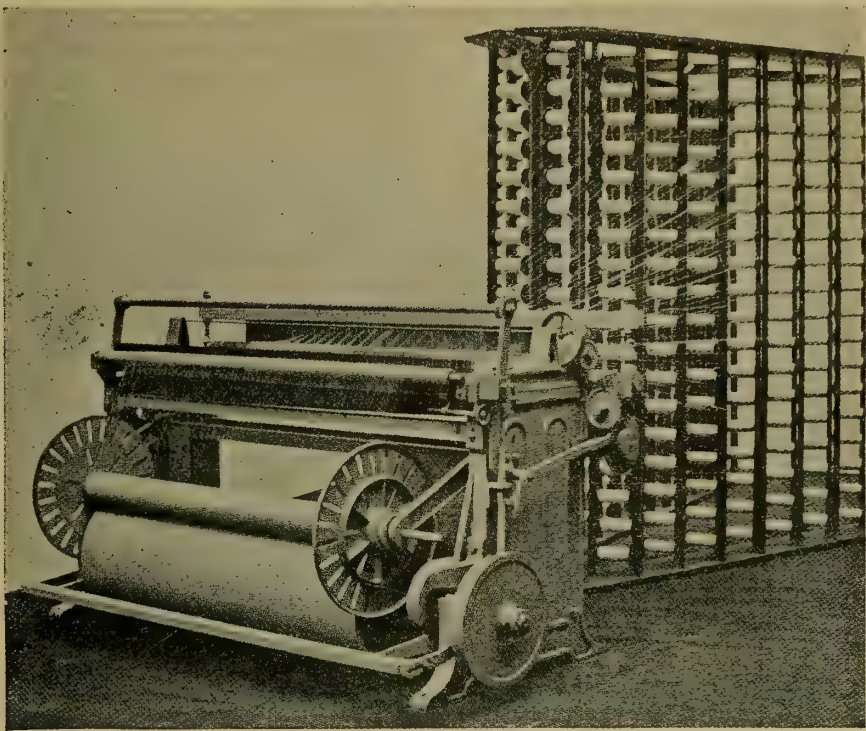


Figure 90. English Warper.

and a new standard of shade provided.

COLOR SHADES.

All the shades in general used at this time were passed on for standards by the superintendent and three cuttings sent to these same departments.

A set of three-inch square pigeon holes in which to keep samples were made. On receipt of each standard of shade of cutting a few grains weight of yarn were taken from the bunch and tagged, indicating number of shade, and placed in a tubular paper box. This box was also marked with shade number and was placed in a particular pigeon hole place, and rolled up in paper to preserve the color in its freshness.

The license taken with reference to color shades was exceeded by the second hand in his interference with orders made on the dyehouse. The previous overseer, as has been said, was very weak on system and depended upon his help a great deal to carry the work through the department. After he had made out his order on the dyehouse he expected that the second hand would take care that the warps were put through on time.

It was the habit of the second hand from day to day after surveying the needs of the hand dressers and looking over the tickets on the pins to call

up the dyehouse and ascertain what was going through, and what grey warps were available to put through, and gave supplementary instructions which would frequently be different to the written orders sent to the dyehouse. This practice was also a contributing cause to the prevailing mix up of dyehouse stock of grey chain warps.

This practice on the part of the second hand was done with the full consent of the old overseer, and to avoid interference on the part of the overseer. If any particular order was not being dressed as fast as he wanted, the overseer would get after the dyehouse and would frequently order that grey warps intended for a specified order be put through for this particular order, regardless of their unsuitableness, in warp arrangement. This would entail a great deal of extra labor in preparing these warps for the dressers, and in this the second hand had a large share.

Through lack of familiarity with chain warp supplies, this order of the overseer would result in the tie-up of another quality for which these assigned warps were intended. It need not require a severe

STRETCH OF IMAGINATION

to realize what would be the condition of dyehouse orders—warps in grey and warps in colors would be in a confusion that would take a long time to straighten out and the second hand would feel justified in taking liberty with the rules governing the handling of the different sets.

The license forced upon the second hand by the circumstances above alluded to become a habit, and he had no compunction in mixing up sets. It may be said at this point that no two sets dyed of the same color are absolutely alike, and it is very difficult to determine how each set will work out before the goods reach the finishing table, even though in the matching they may appear absolutely alike. It is reasonable to expect that all colors will lose some in strength in dressing and weaving, because of friction. The extent in practical experience is variable, and the only safe way to handle different sets is to keep them separate. If compelled to mix sets in the same warp, have each chain reeded in all the way across the warp, and, if possible, confine this sort of thing to fancy warps. No. 224.

CCXXV. LACK OF ORGANIZATION.

In this rather general description of conditions in the hand dressing department there has been but little attempt made to give exact detail, as it would occupy too much space and serve no purpose. Enough has been said that is necessary to convey an idea of the lack of organization, the absence of system, the license taken by subordinates which was fruitful of a demoralization of the worst kind, as this naturally extended to all the help in the department, and the impossibility of an intelligent control of all stock in process and on hand. The colored warps on hand in the warp room, the warps in process in dyehouse, the grey warps available in stock room and the warps in the dyehouse which varied from 200 to 500 warps, at all times were unknown quantities, and the day-to-day supplies were always problematical.

To remedy all

THESE DEFECTIVE CONDITIONS

the new overseer began by calling for an exact report of all warps in the grey on hand in the dyehouse, and the orders they were intended to cover, demanding that all surplus warps be returned to the store house. Comparing this report with the in-incomplete orders for warps to be dressed, the actual condition of the supply of grey warps to meet unfilled orders was ascertained. It was also necessary to know how the orders for grey warps stood on the books of the yarn mills which supplied these warps. By carefully working on these various reports, an adjustment was made which established exact conditions, and very strong orders were issued that hereafter there was no other person authorized to give orders but the overseer himself.

To prevent any possibility of a fur-

ther mix up, instructions covering particulars were given first to the overseer of dyeing that he hereafter confine himself to the orders sent him on the usual order slip form, checking off all warps on their completion and shipment to the dressing room. As a duplicate of all dyehouse orders was kept in the dressing room, the warp man was ordered to check these warps off as they were received from the dyehouse. The shipper was instructed not to send any grey warps to the dyehouse without specified orders, which would be furnished him by the overseer when orders were sent to the dyehouse. The shipper was further instructed to take care of all warps made in the cotton mill. This put under the control of the shipper all warps whether from outside, stock on hand, but also the warps from the cotton mill.

The overseer installed

A CARD SYSTEM

in which each kind of warps was put on a separate card, the number and grade of yarn specified, threads in warp, yards, pounds, warps ordered and from whom, warps received, warps on hand, warps assigned to quality, dyehouse order number and date of assignment. All grey warps received were recorded on these cards by an office girl and provided an accurate record of warps wanted, received or surplus.

It was also found expedient to adopt a card system to take care of small lots of yarn wanted for over lines, and not only the over line for the dressing had to be provided for, but also the over line for the filling—a card for each color and kind of yarn containing a record of pounds needed for each order. When the pounds weight not provided for was of convenient size, an order on the dyehouse was made and warps sent and checked off the stock card from which they were taken, and also a record was made on the overline card as to pounds ordered and dyehouse order number.

These changes marked a great improvement in the dressing room, but there were many other features that caused a great deal of worry and unnecessary expense. As has been said before, grey chains were made either by outside customers or by the mill itself. A few days after an order was received a call from the main office would be made to ascertain if there could be anything done to have some warps dressed of particular quality. As there were no warps suitable for this dressing a report was sent in accordingly, but the delay made it important that something had to be done and some stock warps ill suited for the purpose would be prepared for the dyehouse and sent along.

This preparation is expensive, as it will frequently entail a dressing in the grey, and as these warps replaced warps already ordered, ultimately warps will be coming in that probably will be of no immediate use on their delivery. To eliminate this condition and many others, the new man asked for more warpers that he might make his own chain warps, and this was ultimately granted. No. 225.

CCXXVI. INCREASE OF EQUIPMENT.

In addition to more warpers being added to this equipment a doubler was secured to make the warps from section beams. This doubler was a discarded machine by the cotton mill people, who had no liking for this continuous process machine, but on being set up, it proved to be entirely satisfactory. In all there were twelve warpers added, three of them being of an English make and also secured from the cotton mill. These warpers were driven by friction heads, but the heads were badly out of repair and did not work true. By putting on an American driving motion, these warpers proved of equal value to the rest of the warpers in this department.

The stop motion on these English warpers was of roller type. By putting ridders on each thread, when the thread broke, the ridder would fall between two running rollers and spread them apart. This would release

a catch and the shipper would ship the belt on to the slack pulley, stopping the machine quickly. Another feature was two drop rolls instead of one. They promptly took up all slack in the warp when the machine stopped, both motions doing very effective work.

NEW WARPERS.

There was ultimately added to the equipment of this department 12 warpers, making in all 22, three doublers and two chain beamers, and instead of buying yarn in warps, the yarn was bought on spools, preferably on tubes, as by a re-arrangement of warper creels, tubes ran better than spools, and contained a great deal more yarn, and the pieces were easily emptied, as they would unwind from either end when set up for that purpose.

In warping for chain warps needed in the department, the control of yarn going into warps was obtained. The finding of wrong yarns in bought warps is of too common an experience, and it is not difficult to understand the cause, but the wrong yarns would sometimes get by the dresser and into the cloth before being noticed, producing an effect that would sometimes make seconds of the cloth woven with these warps.

In all yarn mills making warps for the trade the warping to the number is done to the tie-up in a series of warps until the yarn on the spools is run off to a given point, leaving about two ounces of yarn on spools. These are tied out and taken to the spoolers where they are again filled up. If, as it sometimes happens, the length of warps wanted will run the spools down, some will be emptied and all spools in set run very low. The chances are that some of the pieces will contain yarn of a different number, which may have been on the spools for years, and thus several hundred yards of wrong yarn will get into the warp.

It was

THE COMMON EXPERIENCE

in this mill where all spools received from outside had to be returned empty to find wrong yarns at bottom when unwinding. On going more largely into buying yarns on spools, the new overseer arranged to have pieces dressed up on a Scotch warper (mill) instead of wound off on a spooler, and using these warps for purposes where wrong yarn could not do any harm, such as fancy warps, etc. Of course, all extreme numbers, very heavy or very light, were taken out by the man on the mill. This practically eliminated all wrong yarns on warps, but our equipment of Scotch warpers was overloaded with overline work, and two Davis & Furber dressing frames were secured and they did the work just as well as these mills.

As in the case of the slashing department, all orders for warping intended for the hand dresser were made out on a warper ticket. Pounds assigned for the warps called for would be credited to stock card of the yarn wanted, and on receipt of an order from the main office calling for any particular warps, there would be no delays, as the supply of yarns was easily kept up, and still far less stock was carried than had heretofore been done. This latter stock was in warps, and the extra cost of having our yarns in this form had very frequently to be supplemented by the extra charges for repairing and splitting, exceeding the charges usually allowed for yarn shipped to us in warps. No. 226.

CCXXVII. BALL BEARING ON TEXTILE MACHINERY.

Improved construction features and manufacturing processes have now made ball bearings practical for such a wide variety of load and speed conditions, and over such an unlimited field of application, that textile machinery manufacturers are to-day giving thorough consideration to the employment of ball bearings on their machines.

Aside from the improved methods of machining and heat treatment of the steel in ball bearings, perhaps the greatest advance toward perfect service has been the provision within the bearing itself for complete and auto-

matic adjustment to shaft deflection. The sectional illustrations show the construction in which such self-alignment has been accomplished.

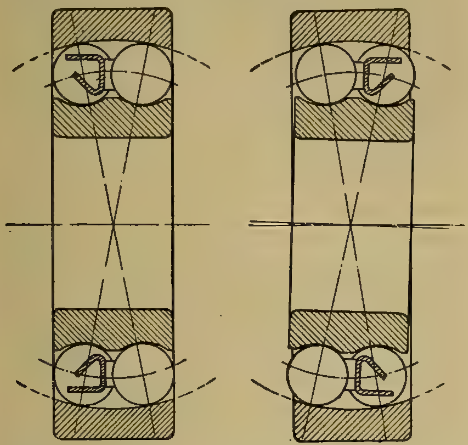


Fig. 1. Normal and Deflected Position of a Ball Bearing, Illustrative of the Action in Conforming to Shaft Spring.

The bearing illustrated has two grooves on the inner race, each ground to a radius slightly larger than the radius of the balls, while the outer ball race is ground on the arc of a circle, whose centre is the centre of the bearing.

The balls, retainer, and inner race are free at all times to

ROTATE AT ANY ANGLE

within the spherical outer race, and will adjust themselves to any position of deflection without binding the balls or races, and without introducing any obstacles to immediate and automatic compensation for shaft spring or deflection. This adjustment involves a pure rolling motion without sliding friction, and is facilitated by the distribution of the load over a large number of balls. As the load is automatically and equally divided between both rows of balls, the most favorable working conditions are attained.

Belt-driven machines offer some uncertain conditions of bearing load, due to belt tension adjustment, overloads on motors or the working of poor stock in the machine. Gear-driven machines, or chain-driven machines, are also subject to such vibrations and variations on account of the gear back lash, slight inaccuracies in machining, or conditions of shock which may come from

FREQUENT REVERSALS

of power on the machine.

Due allowance for practically any condition of speed or load can readily be made, and the experience which has been had on ball bearing applications has shown that they are fully capable of overcoming such difficulties where plain bearings have failed to stand up under adverse operating conditions.

In the matter of

LUBRICATION,

it may be pointed out that ball bear-

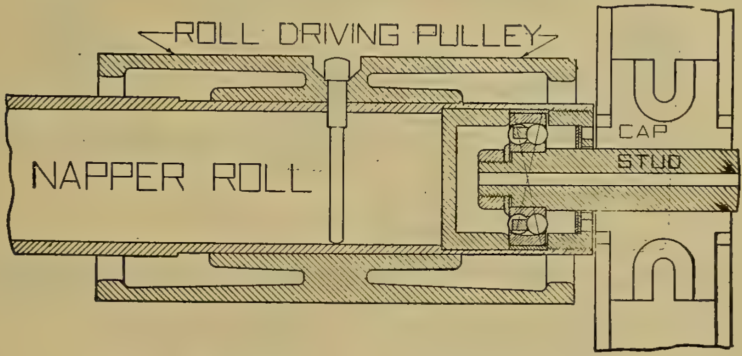


Fig. 2. Ball Bearing on Napping Machinery.

ngs require but very little attention, ordinarily lubricant need be replaced not more than three or four times a year, and the frequency of inspection will be indicated by working conditions. The lubricant should contain neither acid nor alkali, inasmuch as a neutral lubricant is essential for the proper protection of the highly polished bearing surfaces against corrosion. For high speeds it is customary to use a good grade of light mineral oil, but for speeds less than 1,000 revolutions per minute, mineral grease or vaseline may be effectually employed instead of oil.

Figure 2 illustrates an application of a ball bearing, which has met with marked success in the worker rolls of napping machines. The inner races of the bearings are securely locked against the shoulder of a stationary stud, on the periphery of the worker roll cylinder, the outer races having a sucking fit within the rolls. By plugging the inner section of the roll, as shown, and providing a dust-proof casing over the stud adjacent to the stud cap, a large lubricating chamber is provided for, with the lubricant feed direct through the stud.

These rolls operate at a speed of 1,500 revolutions per minute, and in view of their length between bearings, approximately 100 inches, are subject to a certain "whip" or "throw" which can only properly be compensated for by the use of a self-aligning bearing. Thirty-six rolls on the periphery of the cylinder require tight belts, accurate machinery, and bearings of high capacity. The mountings here have effected cleaner production of goods, with

REDUCED OPERATING COSTS,

and have also shown a decided increase in running efficiency over plain bearing machines—the power saving on the worker rolls alone amounting to from 40 to 45 per cent on the total driving horse power of the machine.

Figure 3 shows types of mountings which are applicable to countershafts or loose pulleys, the latter plainly illustrating the simple method which can be employed to overcome "running light" charges; that is, power bills incident to running loose pulleys when power machines are shut down.

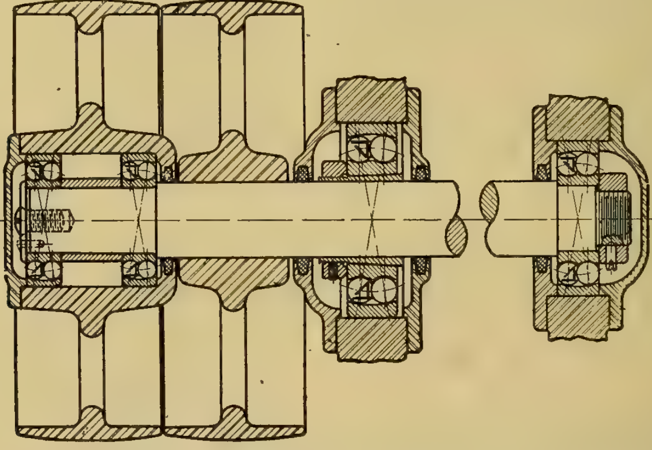


Fig. 3. Mounting of Radial Bearings on Loose Pulley Countershaft Illustrating the Feasibility of Using Ball Bearing Mountings Where Shaft Sizes Cannot Readily be Altered.

The running friction of ball bearings, as compared with cast iron or babbit bearings, can be taken very conservatively in the ratio of 1 to 7.

It may be argued that the power saving on one loose pulley is a matter of little consequence to the producer, but the cumulative saving

in the use of ball bearing mountings brings about a decided reduction in the shop power bill. They give much greater durability and longer life over the plain type of either iron or anti-friction metal. Loose pulleys or countershafts mounted on ball bearings minimize repairs and losses due to shut downs from hot journals and assure the most economical employment of power which would otherwise be entirely wasted. No. 227.

CCXXVIII. SCOTCH WARP MILL.

The warp mill has a traveling head which contains a reed which swings on a centre to control the width of the section as it runs on to the reel. Sometimes a raddle is used instead of a reed on this head, and next to the reel is a roll, over which the section passes as the reel runs downward. This head, when the reel is running, is moved by a screw which gives a taper to the build of the section.

The purpose for which this taper of the section is effected is to prevent the sections from falling over as they are built upon the reel. There is an arrangement or device on the reel bars to provide a taper upon which the first section of the warp may rest as it builds up to the length wanted, the second section building up on the taper of the first section, and so on as each section is run on. This

TAPERING DEVICE

is sometimes arranged to be controlled from a central point, the control affecting all the reel bars collectively. Sometimes it is applied to each bar separately, and the adjustments also made separate, but in either case no readjustment is necessary as long as the warps dressed contain the same weight of yarn to the inch. The same taper is suitable to all lengths of warp run on to the reel of the same weight of warp to the inch.

The distinguishing feature of this machine in comparison with the machines used in this country is that each thread comes from a separate spool and all have the same tension, which prevents slack and tight threads. In this country we put our yarn on to a jack spool 40 to 60 threads to its width. This method is fruitful of tight and slack threads to an extreme degree, and would not have been adopted in this country only because of the lower cost. It will have to be discarded if the manufacturer wishes to make a fabric as good as his foreign competitor.

The reel is some eight yards in circumference, whereas we dress with a four-yard reel. A section built on a four-yard reel would be nearly twice as high as a section built on the reel of a Scotch warper, and this eliminates or at least modifies the probability of high and low sections, as far as dry work is concerned. Pin marks are unknown in warps made on a mill, as in the operation of the section head referred to above there is no need for pins. In dressing fancy warps there is the greatest convenience provided, as, for instance, a large pattern could be dressed from a small number of bobbins by repeating a group in a section by inverting and reversing the sections. There are many such features that could be mentioned that contribute to almost perfect warps.

The item under the heading of

HAND DOUBLING

refers to a method of handling gassed warps. The doubling was done from section beams, sometimes two and sometimes three beams in a set, but this was only an expediency and would not have been resorted to if conditions had been normal. These gassed warps were expected to be dressed in a dry slasher, but the excess of twist in the yarn made it impossible. The long reach in the slasher permitted the yarns to tangle up. In the dressing frames the section beams could be put up very close to the loom beam and prevent all rolling or tangling of yarns. The extra expense in dressing these warps, as stated, was at least three times greater than if slashed.

Doubling was resorted to frequently when dressing fine grades of work. There was a rule in the dressing room that all warp dressed from fine numbers for special qualities should be dressed from four pairs of roads or

dressed to the half warp on separate beams and doubled in re-beaming. This was resorted to, to thoroughly equalize the tension of each thread in the warp. It was the intention of the overseer to cut this rule out after the stock warps on hand had been worked up, as the warps made in his own department met all requirements without the extra treatment above mentioned.

The heading,

RUNNING IN OVERLINES,

refers to a condition which would sometimes come up when special overline had to be dressed in. Heading, Dressing Overlines, refers to dressing overlines on a roller or separate beam to be used separate in the loom. Heading, Redressing, refers to warps re-dressed which in their first dressing were not satisfactory, or when a warp of one quality was changed to another, yarn being added or taken out, or where a warp of one quality was changed to another and was wanted on a beam of a different width.

The heading, Examining, refers to a time when exceptional results were wanted in a particular quality and a special examination would be made to have all imperfect yarns taken out. Most worsted yarns were examined on examining frames, but when hard pushed the hand dresser would do some examining from loom beam to loom beam.

The heading, Long Chain Beaming, referred to the beaming of colored bleached and mercerized chain warps onto section beams to be slashed. There is also a list of general room help which should bear a relative value in wages to the production of the department. Labor charges for preparing samples for looms are also recorded, followed by a list of claims made for bad work and grand total for the hand dressing department. No. 228.

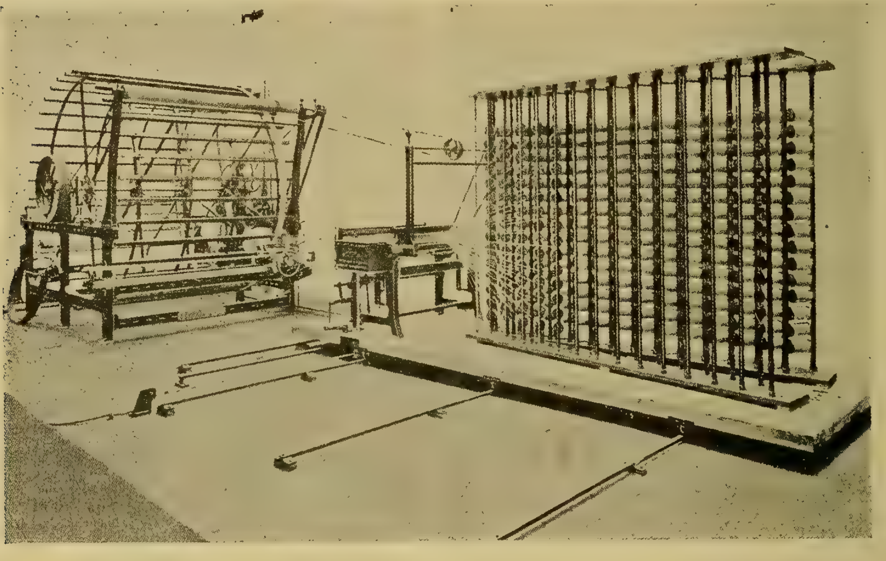


Fig. 92. Scotch Warp Mill.

CCXXIX. AMOUNTS EARNED.

The following tabulated list of the earnings of hand dressers covering a consecutive period of six weeks was taken from the pay roll to illustrate each man's value on the list.

J.H.	17.13	58	17.48	58	16.78	58	15.69	52½	12.27	65½	18.33	65½	27c.
J.T.	16.00	58	12.90	58	15.97	58	14.11	65½	19.26	65½	16.29	63	26c.
W.H.	16.32	50½	10.99	39½	3.72	14½	17.11	65½	21.68	65½	9.28	36½	29c.
E.T.	15.76	58	18.03	58	18.81	58	20.08	65½	17.88	65½	14.51	50	30c.
T.T.	14.37	58	13.70	58	13.59	58	15.90	65½	17.20	65½	14.36	65½	29c.
F.T.	15.08	58	21.78	58	18.64	58	19.29	65½	24.06	65½	19.47	65½	32c.
T.L.	16.44	58	19.30	58	14.35	58	19.39	65½	13.74	52½	12.89	52½	28c.
T.C.	17.31	58	15.33	53	15.15	58	16.53	65½	17.44	65½	16.07	65½	27c.
W.S.	14.32	58	13.50	58	15.78	58	13.93	65½	14.14	65½	14.73	65½	23c.
A.S.	18.28	58	15.24	58	15.15	58	16.12	65½	18.27	65½	16.74	65½	27c.
J.S.	12.40	58	12.11	58	12.49	58	17.40	65½	18.06	65½	15.18	60½	24c.
F.K.	16.13	58	15.94	58	9.50	58	15.74	65½	16.52	65½	13.95	65½	24c.
T.T.	16.31	58	11.70	58	13.50	58	13.03	63	16.16	63	17.58	65½	24c.
‘.S.	17.57	58	15.36	58	16.06	58	17.44	65½	19.79	65½	18.45	65½	28c.
I.K.	14.01	58	17.15	58	14.59	58	17.14	65½	14.48	65½	17.36	65½	26c.
J.M.	17.08	58	16.02	58	15.11	58	16.42	65½	17.94	65½	15.99	65½	27c.
C.R.	9.21	58	13.54	58	13.03	58	15.07	65½	11.37	65½	15.48	65½	21c.
J.R.	13.61	58	15.19	58	16.70	58	13.99	65½	15.21	65½	13.63	63	24c.
J.T.	16.79	58	16.61	58	13.24	58	15.56	65½	18.23	65½	20.94	65½	27c.
J.R.	15.30	58	16.91	58	16.76	58	16.79	65½	20.24	65½	17.27	47½	29c.
L.N.	13.41	58	14.02	58	13.18	58	16.65	65½	18.98	65½	17.50	65½	25c.
F.K.	13.70	58	15.31	58	15.29	58	14.48	65½	17.74	65½	17.47	65½	25c
L.M.	13.92	58	6.82	32	12.54	58	12.49	65½	14.08	65½	9.87	47	21c.
E.T.	18.79	58	13.81	52½							16.80	58	29c.
J.B.	19.70	58	17.01	58	15.73	58	19.21	65½	21.62	65½	15.24	63	29c.
H.R.	13.69	58	15.84	58	13.85	58	19.61	65½	19.10	65½	20.01	65½	28c.

From this list a fair idea was obtained of the comparative efficiency of men in general. A summary of this is as follows:

	Per hour.
2 men	$.21
1 man	.23
4 men	.24
2 men	.25
2 men	.26
5 men	.27
3 men	.28
5 men	.29
1 man	.30
1 man	.32

The above indicates what may be expected of the average help paid by the piece.

The difference between the lowest and highest earnings is 52 per cent. The average of the above is 26½ cents per hour, the percentage of difference between the lowest and the average is about 21 per cent, and the difference between the average and the highest is 26 per cent.

This tabulated list covers all sorts and kinds of goods hand dressed, during the six weeks mentioned. Shortly after the new man took hold, he wished to obtain data as to the relative value of each man on dressing the same qualities. He, therefore, instructed the second hand to observe closely the period of time each man took to dress each warp, and make record on dresser's book, and also make a report from day to day. The following is a tabulated list of data obtained, maximum time, minimum time, and average time taken to dress each quality, maximum, minimum and average time computed on a rate of 25 cents per hour, price paid for day work. By taking the first item, the price for dressing, $3.40 divided by eight hours equals $.425, the sum earned by the operator. If paid by the hour, the operator would have received 25c. x 8 equals $2.

This table was of much value in dealing with a certain class of inefficient help who, when they got a poor job during the week, would play for an allowance; that is, they would hang back in all their work during that week. It had been the practice in former times to allow a man the difference that he was short of his rating, but with this table, if a man insisted on a claim, his work for the week would be looked over, and if he evidently had an opportunity to make pay, no allowance would be made.

On the call for the data from which the above table was made, a general

FEELING OF DISTRUST

of the purpose of the new overseer was manifested, and the men thinking this was preparatory to a cut-down, got together, and agreed to what is called a stint. This meant that no man was at liberty to put in another warp on any week after he had made so much money. This mistaken view on the part of the men was fruitful of a great deal of trouble among themselves. As an illustration in a stint of, say, $13, if a man had $12.99 made, he could put another warp

in and bring his pay up to about $16, but the man who had made $13 was debarred from earning more. It ultimately became evident that there were far more disadvantages in the stint than advantages, and it became inoperative, as indicated in the above table of average earnings. No. 229.

Qual.	60 yds. Cuts.	Price.	Maximum time.	Minimum time.	Average time.	25c. rating per hour. Maximum.	Minimum.	Average.
4129	20	$3.40	13.40	8.00	11.1	3.32	2.00	2.77
4141	20	2.88	11.35	5.15	9.20	2.84	1.29	2.30
4135	20	2.49	10.00	7.15	8.1	2.52	1.79	2.02
3618	12	3.03	12.15	11.20	11.6	3.04	2.80	2.91
3769	20	3.49			10.45			2.61
4109	20	3.54	12.30	10.10	11.10	3.08	2.52	2.77
3763	20	2.69	8.35	5.45	6.74	2.09	1.36	1.68
4101	20	3.46			8.45			2.11
4142	20	3.36	10.45	5.45	8.48	2.61	1.36	2.12
4151	14½	2.24	8.20	7.30	7.75	2.05	1.82	1.94
6063	10	1.51	5.60	3.30	4.5	1.40	.82	1.12
4130	20	3.43	9.30	9.10	9.7	2.32	2.28	2.42
4138	20	3.62	11.00	9.15	10.7	2.80	2.29	2.67

department from an administration by sufferance to a well-organized department. At this point, we find the new overseer saying that it would not cause any inconvenience to him if the department was increased to twice its size. The data obtained through this organization made mani-

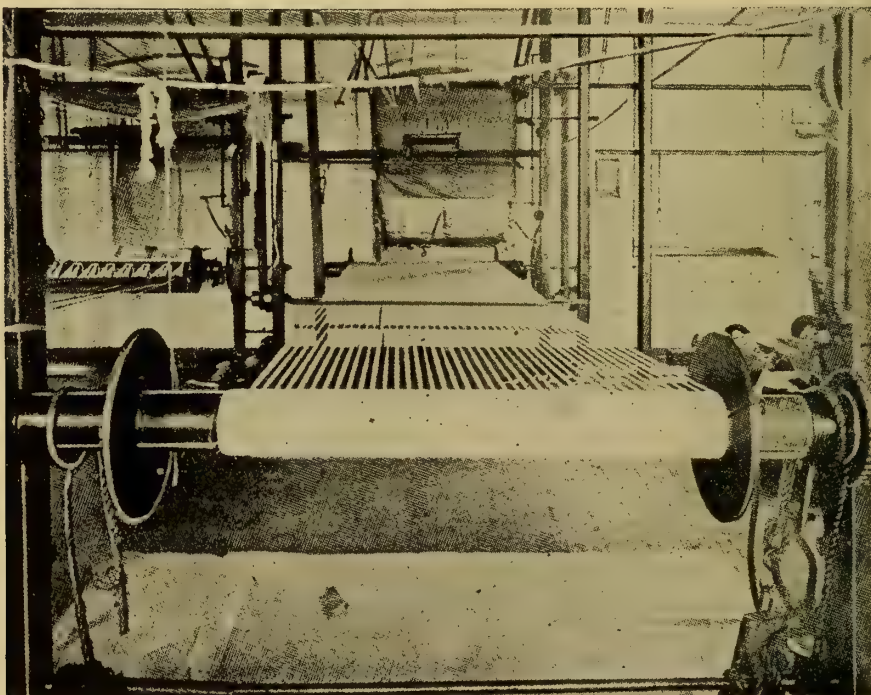


Fig. 93. Re-Dressing.

CCXXX IMPROVEMENTS EFFECTED

Since the opening of "CCVIII, Importance of System", previously published, we have described the developments of a

fest all features of weakness in the department, and when a new idea to improve matters was being tried out the results were made apparent in the report in a way that could not be mis-

understood, either for or against the experiment.

In this mill, there frequently occurred radical changes in the fabrics made. Sometimes, it was what was called a slasher's season, and sometimes a hand dresser's season. These radical changes had to be met as they came up. The treatment of these conditions may be illustrated by the change that took place when the demand for hand dressed work was greatly in excess of all previous experience in this mill, and a corresponding reduction of call for slashed warps.

Expediency compelled the consideration of slashing of hand dressed warps. The difficulties to be met in slashing the many qualities were various; most of the lone black warps were very thin sheets, and the slasher under ordinary conditions could not produce the best of level webs. The warp threads in these warps occupied one-fourth the space of that provided in the width of the web, and the threads would run on to the beam bunched in groups of several threads forming ridges on the loom beam.

SLASHING THIN SHEETS

To obviate this condition a vibration of the top roll of one-quarter of an inch was effected by putting a cam pulley on the delivery roll, a groove being cut in its face, describing a wave variation of a quarter of an inch, and a disk wheel being fastened on the top roll resting in this groove of the cam pulley, every revolution of delivery roll would cause top roll to move backward and forward once.

Each single motion changes the position of the threads of the warp as they run onto the loom beam one-eighth of an inch, this change taking gradual effect during the running of about eight inches of warp. By means of this arrangement, these sheets were slashed, and the webs on the loom beams were superior to hand dressed warps. This idea of the new man's simplified his problem very much.

ANOTHER INNOVATION

he introduced, and which gave the balance of relief needed, was the rearrangment of the slashers to handle bleach and black warps, for black and white goods.

As these goods were filled with a bleach wool and a cotton black, it was essential that the white in the warp should retain its clearness of bleach. To retain this pure white, it was found impossible to size the bleach in the same vat as the black. To meet this condition, there were two size vats used.

As has been mentioned before, the drying arrangements in these slashers were hot air chambers, and by carrying the bleach yarns through the size of the nearest vat, and to the top roll of the drying chambers and the black yarns under the nearest vat and through the size of the second vat, and entering the drying chamber at the second roll, each chain of black and bleach coming together on the second front roll, each having run separate one length in the hot air chamber and setting the size. The change made in the slashers was very small, consisting in a roll put under the nearest size box to carry black chain clear of the size box, under which it ran, and a re-arrangement of some of the carrying rolls.

The warps for small checks were run through the raddle in the usual way, and the colors separated when the loom beam was taken off and lease picked by girls, but the bigger patterns which were called for had to be picked-in in the raddle to get a free shed in the loom. As there were large orders on both of the above grades of goods, the hand dressers were free to handle the fancy grades, and the department was made to balance the hand dressing season.

There are no appliances in use in the dressing room that have such far-reaching effect in the making of warps for the loom as

THE EXPANSION RADDLE,

comb or reed. These appliances are generally all made on a same common principle. The dividing wires are held in position by two sets

of double springs, one wire between single coils of each double coil. By stretching the springs, these wires are spread apart, the threads between the wires being distributed over a larger surface, supposedly equidistant from each other.

The operator when winding out the raddle on warper should aid each wire into its correct place by running first finger and thumb along the front and back of wires from the centre to the sides. This is very important, as in raddling out, the wires nearest the side raddled from will spread out more than from the other side. If this is not attended to, the beam will not be level, and when in the slasher, the yarns will run off tight and slack, and cause bad work for the weaver.

The tight threads will probably break of themselves; the slack threads will tangle up in the slasher, and if they do not make a smash, they will at least cross up the warp for the loom. In addition to this, the cloth woven from these warps will be relatively bad. The same may be said of slasher raddles, but not to such a great extent, as the springs in these raddles are much stronger, and consequently, more accurate in distributing the wires of the raddle. No. 230.

CCXXXI. SELVAGE SPOOLS.

In this mill, there were a large variety of fabrics made that required a selvage of a different take-up than of the ground or warp. This made it necessary that the selvage for these warps be put on separate rollers or spools.

The winding of these spools had been done on a frame of very

CRUDE CONSTRUCTION.

The front part of an ordinary hand dressing frame was used for the drive. A shaft containing some five or six narrow drums extending the width of the dressing frame, was fastened in the socket of the driving shaft. On these drums, the selvage spool was placed and supported in position by a spindle attached to a lever. This lever being fastened to a cross-brace on the frame, the threads were spaced by a raddle placed at the back of the frame, and at the rear of which a stand was placed, arranged to take spools. To the above lever, a weight was hung, when a thread broke, the big weight had to be taken off to secure the end to tie up.

One raddle had to do service for selvages of various numbers of threads, and the spacing was in most cases very uneven, making high and low places. The winding was, on that account, very unsatisfactory, and the operator would endeavor to level his spools by guiding the yarns to the low places in his spool with his hand. Low places would sometimes be caused by the weight which hung on one side of the spool, and caused the latter to be lopsided. It may easily be conjectured by the above the condition selvage spools were in when sent to the weave room.

These selvage spools were a source of a great deal of trouble and annoyance, as they involved the question of who should be responsible for the making of them, the old overseer contending that the weaver should prepare his own selvage spools.

THIS ATTITUDE

of the dresser prevented any improvement being effected. With the advent of the new man, this matter was gone into fully, and although it took a long time, he devised a winder that met all conditions to the highest point.

The frame of an ordinary jack spooler was used; the drum rolls and all cross bracings were removed, and the two outer frames were braced together, 12 inches apart. Rolls, Figure 94, were made to suit this width, and a drum, 12 inches in diameter, and a 3¾-inch face width, also shaft of drum to width of machine, with inside collars on shaft to keep drum centred. A split back roller guide was made, and cut 32 spaces to eight inches. This guide was 14 inches long, and had a slot at one end, two inches long, in which a thumb screw was put to hold the guide in position. This slot enabled the operator to change the position of the threads on the roller, and prevent the

rollers becoming ridgy through too much wear on any one point.

The spacing of the yarn, as it ran on to the spool, was done by a special device; there was no room for the traverse of guide, nor was a traverse needed, as the yarn run on was very compact, but it was important that expansion and contraction of the spacing should be effected, so that the same guide could be used to make all selvage spools calling for various numbers of threads to the same width, and that the guide should be

SUSCEPTIBLE TO ADJUSTMENT,

latterly, both these requirements were met.

The device, Figure 95, consisted of a square inch bar, B, about 12 inches in length, one end fitting in a square inch hole in the frame, A, of the machine. At the opposite side, this bar was engaged by a screw, F, this screw passing through the frame, A, of the machine, and having a collar on the inside, and a head, H, on the outside, by which the operator could make all necessary lateral adjustments. This was necessary, as a large play was required by the spools in winding because of their large heads, which frequently became more or less warped, thus changing their centre.

On the above mentioned bar, a metal strip, C, was fastened at its centre, with a bolt passing through the bar, and engaged with a thumb nut, D. This metal strip was eight inches long, and had 33 pins, E, 1½ inches long, spaced one-quarter of an inch. This strip could be adjusted at any angle, and could group threads in a uniform spacing of from eight to 32 threads in the spool width of four inches.

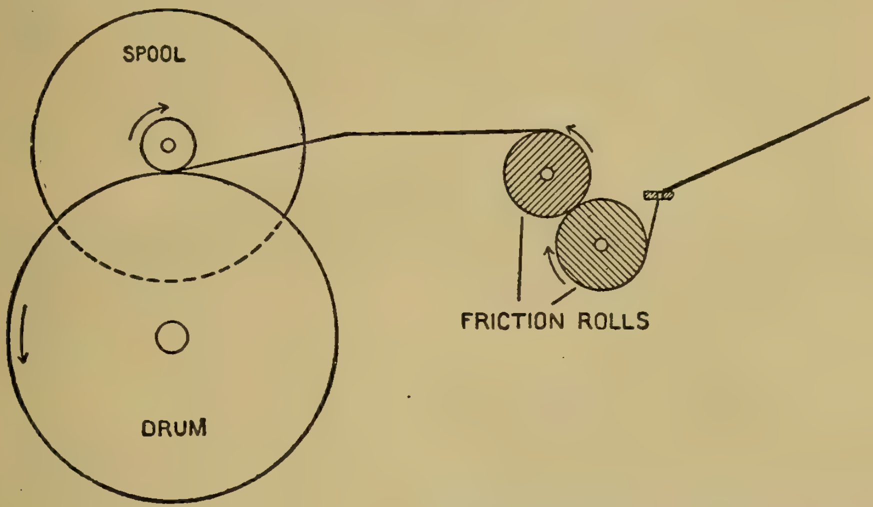


Fig. 94. Drum and Rollers.

At each end of the top roll was fastened to the roller spindle grooved pulleys smaller in diameter than the roller body. Around these pulleys, a friction rope or string was put to regulate the tension of the yarn. At the back of the frame was placed a stand to hold spools from which the yarn was taken as it was wound on the selvage spool. This stand or creel was of the type used in worsted jack spooling, and had a light wooden lever resting on each spool to prevent the spool running too free. A clock could be used, if desired, and measurements made to the exact length wanted. This was done, but it was found to be of

NO PARTICULAR ADVANTAGE,

and it required a higher efficiency on the part of the operator and more unnecessary care in running the machine.

With this machine, an excellent selvage spool was made, and the facilities that it provided the operator secured a production equal to all the needs of the weave room. With the original machine, it was frequently found necessary to put on extra help to get out sufficient selvage spools, to keep the looms going, and this, at a time when there were fewer looms on qualities taking a separate selvage spool.

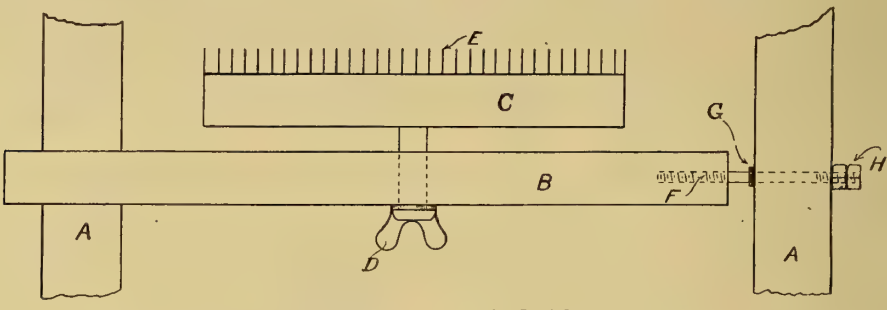


Fig. 95. Thread Guide.

Figure 96 is a sketch of a selvage spool. This spool, containing yarn, was hung on the loom in such a position to work free on a spindle, and allow the yarn to pass to the roll from which it passed into the harness. The tension of the yarn was regulated with weighted strings placed in the groove A of spool head. If practical, the yarn was made to run around the warp beam, but this eliminated separate tension control. No. 231.

CCXXXII. FRICTION RACK.

With the purpose of obtaining exact data, a series of tests were made to ascertain the relative value of the frictions obtainable in a dressing frame. Friction is created by cross bars in the friction rack overhead, and the cross bars on the back frame. The chain passes first into the friction rack, and then to the back rack, and, if needed, the chain will be brought to the front frame again, and passed around a roll, and then to the back frame, where the different parts may be distributed over the various bars.

The friction of the rack is obtained by two rows of rolls of five bars on the top, and four bars on the bottom row. (See Figure 97.) These bottom bars are all fastened in the frame, all but the first of the top bars resting in square seats, and are used to regulate the tension on the chain. The first top roll, A, is fastened, and around it the chain

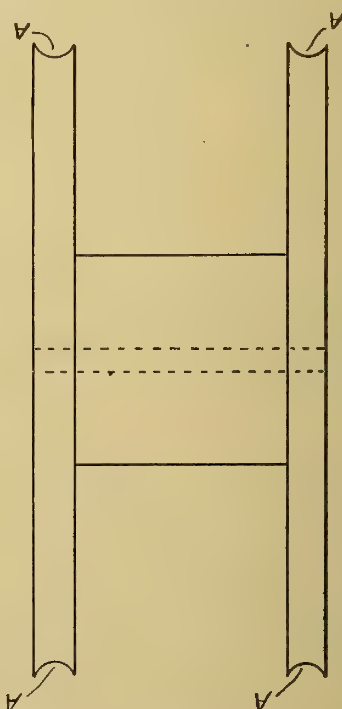


Fig. 97. Friction Rack

first passes as it leaves the floor, and then under B, and it may pass to bar H, and be carried to and over Bar I,

to the back stand, or it may be carried to K, and then to back stand top bar, bringing the chain to the front, and passing it around Bar J and again to the back. The latter arrangement is called a double reach.

In either case, the friction rack may be manipulated to increase the tension on the warp by carrying it up and around C, E or G bars, and by test, it

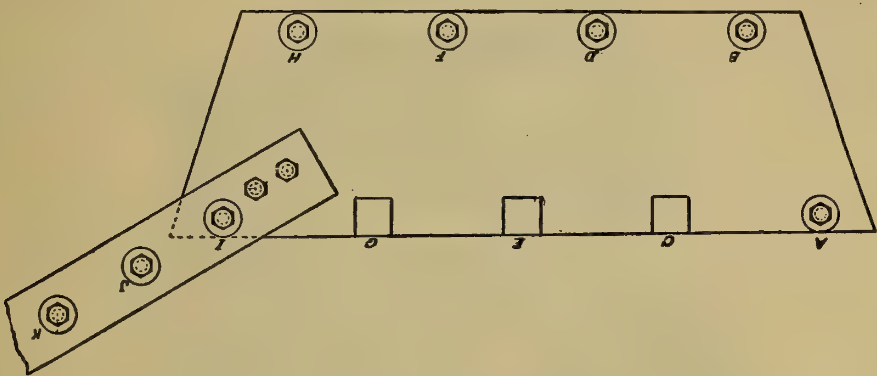


Fig. 96. Selvage Spool.

was proven that a warp in a double reach, running clear in friction box, had the same tension as a warp on a single reach, with a full rack, that is, the warp passes around all the bars in the rack.

The test referred to was made with a gray warp of 1-30 carded, 835 ends, which was not only put through the friction bars mentioned, but was carried to and around the bottom bar on the back stand, and again, to the front and over a light roller at that point, weighted to offset the friction resistance with the following results.

With a full rack, or with a double reach alone, it took 24 pounds to start the chain moving. By taking out any one of the top rolls, 12 pounds would start the chain, by taking out any two rolls, six pounds would start it, any three bars, three pounds and all four, one and one-half pounds. By manipulation of friction, the following may be obtained:

Full rack and double reach	48	pounds.
3 bars and double reach	36	pounds.
2 bars and double reach	30	pounds.
1 bar and double reach	27	pounds.
Full rack or double reach	24	pounds.
3 bars single reach	12	pounds.
2 bars single reach	6	pounds.
1 bar single reach	3	pounds.
	1½	pounds.

Without doubt, the same results may be obtained in exactly the same conditions, but there are so many factors to be considered that will affect results, for instance yarn in the grey, bleached, black or colored will bite the bars differently, and variations will be found in the amount of size on warps, which will also change the results, but the value of these tests consists in showing the relative value of each arrangement of friction bars, and enable the dresser to make his adjustments intelligently. No. 232.

CCXXXIII. FILLING WINDERS.

The quiller referred to in a previous section of these articles are sometimes known as filling winders. They are adopted to run from skeins, as well as from bobbins, and have a variable wind, which is affected by two eliptical gears. (See Figure 98.) This variable wind is essential when winding from skein, and is important when winding from spools.

By way of explanation, it may be said that as the bobbins have a tapering head upon which the wind is

made as the guide travels from back to front, the take-up of the yarn by the bobbin would correspond to the diameter of the bobbin at the point on which it was winding, and the take-up would vary proportionately, and as the guide performed its travel, there would be about six times more yarn wanted at the head of the bobbin than at the bottom of the taper.

By the use of eliptical gears, an arrangement is effected whereby, as the guide passes from the head of the bobbin to the bottom of the taper, the spindle increases its speed, and as it recedes back, decreases its speed and a consequent uniform take-up of the yarn from either skein or spool. This simple arrangement has made it possible to wind on filling bobbins, and most tender yarn, which would otherwise be impossible.

TENSION OF YARN

is governed by an angle iron swinging on a pivot pin at about its centre, the outer curved end resting on the spool, the rear end being weighted by a slid weight and placed at a point where it would give the desired friction to effect a suitable tension on the yarn as it was wound.

This method of contracting the tension has some very good points. The usual method to develop tension in winding is to cause the thread to run around a series of cross rods or wires, themselves causing a restraining friction on the yarn as it is wound, and when correctly done, the tension will give good results in producing evenly wound bobbins, but when yarn is rubbed much, it becomes shiny; particularly is this so with worsted yarn. This is very undesirable and objectionable, and is to be avoided as much as possible.

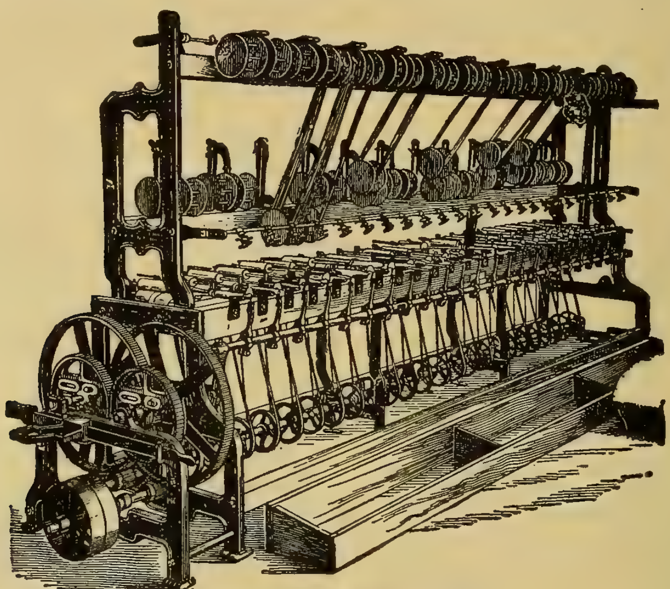


Fig. 98. Skein Winder.

In the Altemus winder, the yarns run free from the spool to the bobbin, with but a little friction from the lever mentioned above, not on all sides of the thread, as with the cross rods, but only at one point of the spool.

On the cross beam on the top of the machine is a row of spindles to hold the twister bobbins, from which the filling is wound. Each of these spindles rest in a casting free to rotate. Friction may be obtained by banding the base of each spindle to

the extent desired. Figure 99 shows the same machine as Figure 98, rigged up for skein winding. The barrel system is used to hold the skein. This is preferred by a large number of people as being more convenient than the swift system, as the latter required continual adjustment.

The top barrel is a fixture; the bottom barrel is fastened on the end of a lever with a weight adjustment which automatically keeps the skein taut as it unwinds. By the lever arrangement, it is very easy to put on a skein, putting first on top barrel, and by raising the bottom barrel the skein slips on very easily. No. 233.

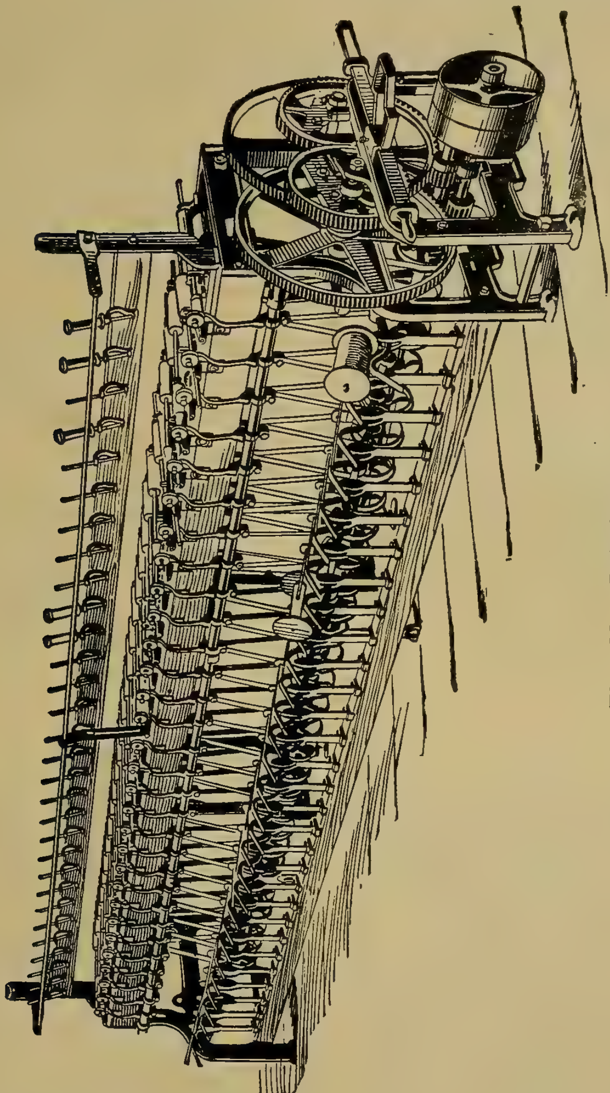


Fig. 99. Bobbin Winder.

CCXXXIV. MEASURING ON A SLASHER.

It seems strange that manufacturers should be content with the measuring attachments, which are found on slashers in general. Whatever the arrangement of gearing, the constant

in use will not give length to the net yards, but will invariably give yards, and an inconvenient decimal fraction. Try, for example, the constant 2,000 which is in common use to be divided by either yards wanted or gear, say a 31-gear: 2,000 divided by 30 equals 66.66 yards, or 2,000 divided by 31 equals 64.51.

The difficulties to be met in a fancy mill, where it is found expedient and necessary to put warps on more than one beam, to obtain accurate relative length under this condition may be easily conjectured. In the case of two-beam work, after the warp beams that have the cut marks are slashed, the second beams may be slashed to the aggregate proportionate length, the gearing arranged accordingly. This entails a good deal of figuring, and exceptional care on the part of the slasherman, and it prevents a very essential provision—a provision which enables the weaver to regulate the tension of each beam, that is, by having cut marks on each beam of relative length, which provides an indicator of the take-up of each warp, as the weaving proceeds.

It is recognized as

AN IMPORTANT FEATURE

in the weaving of cloth that the tension of the warp yarns be at all times the same, not only through the weaving of a warp on one beam in the same loom, but also the same tension in all warps of the same goods. Yet, there is a marked difference in the way weavers, when left to themselves, will regulate the tension of their warp. Some will want their warp easy in tension, and others will want their warp as tight as a drum's head. This disposition will continually manifest itself with all weavers.

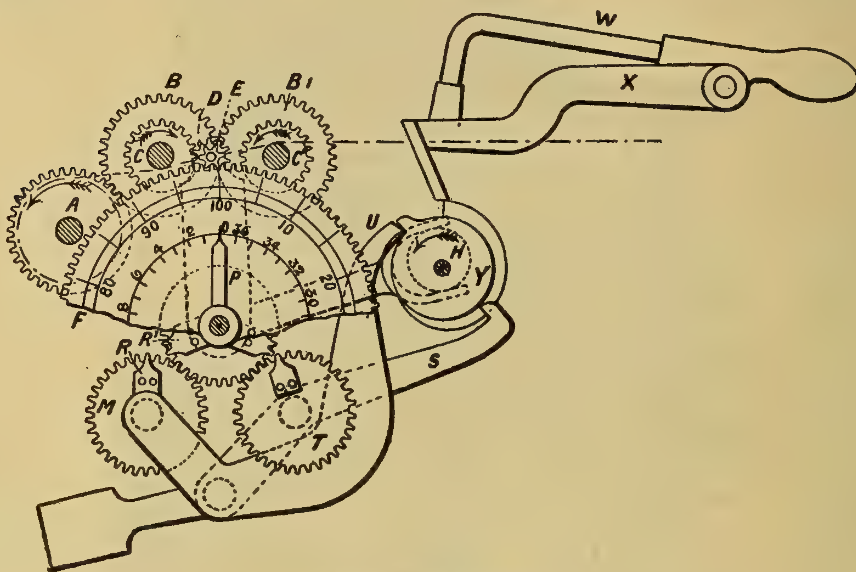


Fig. 100. Elevation.

To weave a warp with an easy tension will cause the warp to bend over the filling and produce cloth that is not balanced, the warp being too prominent. The reverse would be the effect if the warp was woven in too tight. These points may seem too nice to receive consideration from some men, but it is just such nice points that determine the distinguishing difference between the product

of the efficient workman, and that of the inefficient workman.

This reference to warp tension in weaving is done to emphasize the importance of

EXACT MEASUREMENTS,

and the necessity of having corresponding marks on each warp where there is more than one warp used in the weaving of the cloth, but this is not all nor the only reasons why cuts should be made of any desired length, but the simplification of all features in the making of cloth calls for a more easily calculated measurement and a gearing to provide cut lengths to any measurement desired, without any abstruse decimal fractions to deal with but to the inch. No. 234.

CCXXXV. ADJUSTABLE MEASURING INDICATOR.

At this point we will describe a slasher adjustable measuring indicator, which met all of the above requirements, and was used in the department on one slasher, while the other slashers were all equipped with the usual cloth system of gears. This adjustable measuring indicator was so constructed that by making an adjustment, any length could be measured to the cut or warp without changing gears.

The following figures—elevations, sections and plans—will help materially to elucidate the details, and render the action of the mechanism clear. Figure 100 is an end view of the arrangement; Figure 101, a plan of the same; Figure 102, an elevation of the reversing gear, color bowl and box; Figure 103, a plan of same, and Figure 104, elevation of improved marking bowls.

The first motor in this arrangement is the ordinary measuring roller, A, Figure 101, 14.4 inches circumference, in use in nearly every "slasher" sizing machine. This rollor at the offside of the machine carries a spur wheel of 36 teeth, gearing with a spur wheel, B, of 35 teeth upon the first of two "sheeting" rollers, which wheel gears into another of the same size upon the sheeting roller. The use of these rollers is

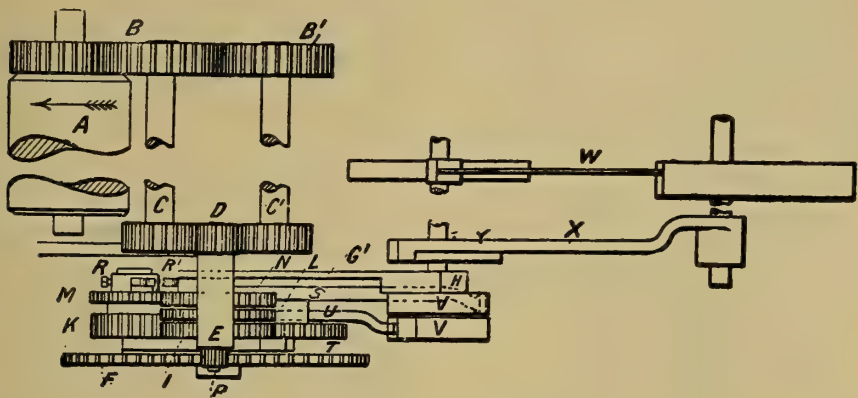


Fig. 101. Plan.

TO PRESS THE THREADS

of the warp into an even sheet as their pass upon the beam.

These sheeting rollers upon their opposite ends carry the spur wheels C and C1, each containing 30 teeth, which alternately enter into the gear with a small pinion or reversing wheel D, containing 15 teeth, upon a small shaft or arbre, the opposite end of which carries a small driver E, of seven teeth, which gears into and drives the dial-plate wheel, F, containing 100 teeth. This short shaft or arbre and its two wheels are cast

in one piece. The dial-plate, Figure 100, the periphery of which forms the spur wheel F, is marked and figured in two circles. The divisions of the outer of these circles are smaller in value than those of the inner one, being 100 in number, in sections of five, and representing one inch for each division. This outer circle is read by the position of the figures as they stand in opposition to the dial-plate driving wheel E. The inner circle is numbered up to 36, and its figures in succession represent 100 inches. Thus, when the pointer registers 36 on the inner circle, it shows that 3,600 inches (equals

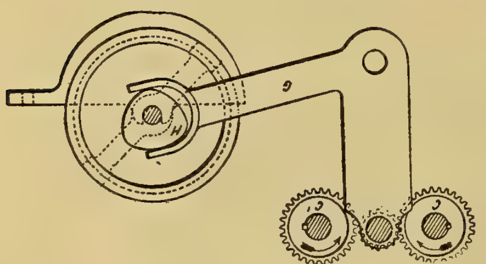


Fig. 102. Elevation.

100 yards) have passed upon the beam.

We come now to what may be termed the second portion of the mechanism, the functions of which are to operate

THE DIAL-PLATE POINTER,

and alternate the direction of the revolution of the dial-plate. The short shaft, carrying the wheels D and E, runs in a bush affixed to the top of the angle lever G, an enlargement of these parts being shown in Figure 102. The opposite end of this single lever forms an open fork, in which the cam H intermittently revolves. Behind the index-plate wheel are a number of additional wheels, not yet described.

The dial-plate wheel F is keyed upon the boss pinion wheel 1, containing 37 teeth. This wheel actuates a carrier-wheel K, which in turn does the same for the wheel L, which contains one tooth less than the wheel I. The index pointer P is mounted on the boss end of the small centre wheel L. On the boss of the carrier wheel K is an adjustable wheel M, giving motion to the corresponding loose wheel N. Each of these wheels has a projecting tooth RR1, which, by its conjoint action, depress the wheel M on the end of the lever S, when its opposite end releases its cam, and allows the cam H to make about half a revolution.

This gives one change to the revolution of the dial-plate, by lifting the reversing wheel D out of gear with one wheel, and placing it in gear with the other, revolving in an opposite direction. This brings back the

MEASURING MOTION TO ZERO,

or nothing, when a corresponding pair of projecting teeth in the wheel T, which is mounted on the middle part of the balanced lever U, depress the hook end of the latter from the cam V, and give a forward movement to the measuring and marking mechanism. By this means a continuous automatic reversing motion is kept up, turning and reversing the dial wheel and its pointer from any position to which it is set.

To insure an understanding of the operation of this indicator, we will refer back to wheel I, which is keyed to dial-plate F, as has been said. The dial has 100 teeth, each tooth representing one inch in measurement Wheel I has 37 teeth, and engages carrier-wheel K, which also meshes with wheel L. This wheel contains 36 teeth.

Pointer P is mounted on the boss end of centre wheel L. Each revolution of the dial and I wheel leaves the pointer attached to L wheel, containing 36 teeth, one tooth or point ahead on the dial, each point on the central figure representing 100 inches, and one revolution of the pointer on the dial 3,600 inches, or 100 yards.

No. 235.

CCXXXVI. SETTING THE CLOCK.

When starting a new measurement, the index pointer is placed at zero on the dial. This is done by bringing gear E out of the mesh with the dial gear. This is provided for, and is easily accomplished with this gear cut of mesh, the setting of the clock at zero being effected promptly. By running the machine to the length wanted, and setting projecting tooth of gear M into reverse motion, the cut marks are put in, and the next cut will be measured back to zero on the clock.

The marking of the warp at the point in length desired is effected by the marking hammer W and the cam lever X, which are actuated from the shaft carrying Y and Z.

Figures 102 and 103 show in elevation and plan enlarged view of C, Cl, D, E, the lever G, and cam Z. The cam Z is mounted on the shaft A1, driven by a continuously running belt on two loose pulleys, B1 and B2, between which is fixed to the shaft a narrow pulley, D1. The driving force obtained from this narrow pulley is easily held in subjection for giving the necessary changes of the reversing motion by the cam and its two levers. On the same shaft is also mounted the cam that strikes the mark at every half of its revolution.

In Figure 104 is shown a marker, consisting of three bowls, geared together, and

OPERATED BY ONE DRIVER,

and constructed and arranged in such a manner as that when the centre one comes up, a single mark shall be struck, this being intended to indicate mid length of "middling marks", as the case may be. For heading marks at the end of the pieces, or "cut marks," a double mark will be made by the two outside bowls being struck by the hammer. Along the space left between these, it is intended that the weaver should cut the cloth at the ends of the pieces. It will be obvious that the marks are made when the bowls present their flat sections to the stroke of the hammer, the rounded portions not being prominent enough to come into contact with the yarn when the hammer strikes, which is shown by the position of the centre one in the illustration.

Of course, the hammer is constructed with three faces to meet the requirements of the change. It will be obvious that this will be, in this line, a considerable improvement quite doing away with the liability of the weaver to cut out at the wrong mark, owing to having lost count, or making a mistake from weaving too much cloth on the roller at once. It will further, by its boldness, better define the mark, and diminish the risk of inadvertently weaving it in, leading to the making of short length pieces, and will thus prevent the mischief and annoyances resulting from these.

MEASUREMENT IN METRES.

By putting on a dial which can be provided, and replacing the measuring roll by a roll of proper dimensions, the measurements may be done in metres. All in all, this measuring indicator

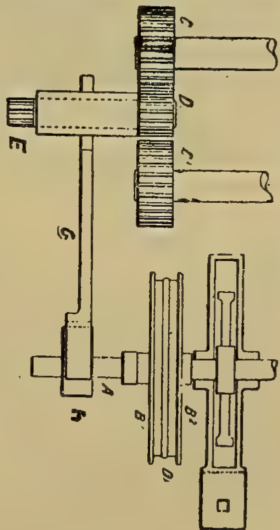


Fig. 103. Plan.

proved itself to be very accurate and convenient, and it is of great value where there are a great variety of cut lengths. It is extremely simple to operate, no abstruse formulas and con-

stants to be used in figures, and it gives a measurement to the inch; whereas, in the gear slashers, there are few gearings that will give exact yards.

There need not be any waste of yarns of warp because one of the beams runs short of the other, the balance of which is made into waste, and nobody knows who is at fault, the weaver or the slasher. With this indicator, the weaver will have corresponding marks on each warp, which should weave in together, and he is provided with conditions that will compel his attention, and make it nearly impossible to find an excuse for a beam running out before its mate, and, in effect, securing from him a cloth uniformly well balanced.

No. 236.

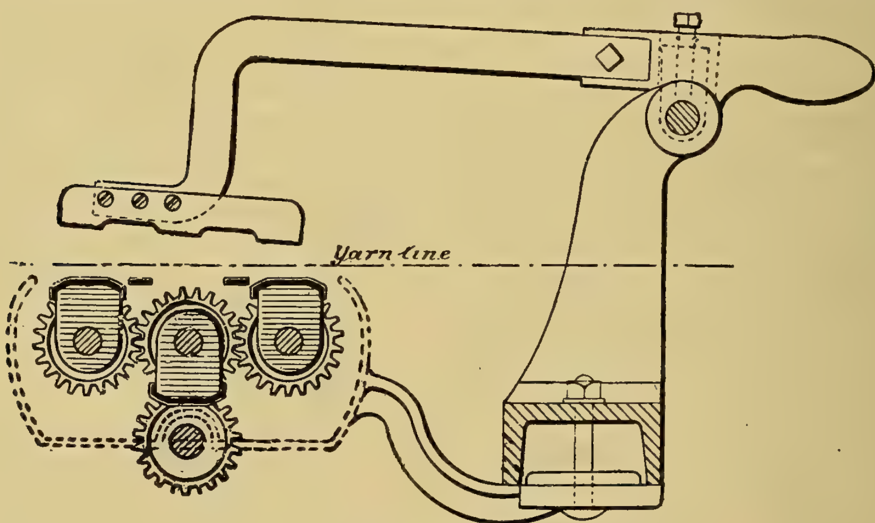


Fig. 104. Marking Bowls.

CCXXXVII. REELING.

To provide the dyer with conditions suitable to color yarn, reeling was resorted to almost exclusively, but in these latter days, chain warp dyeing has very largely taken the place of skein dyeing, by reason of its greater facilities, in most respects. This is particularly true where large quantities are used, but the smaller lots will continue for some time to be colored in the skein. Although reeling is a very simple process, the overseer of a cotton yarn mill finishing department does not find it profitable to neglect to give reeling its share of consideration.

The customer who wants his yarn reeled his own particular way, and the spinner who makes the yarn, and the operator who runs the reel, furnish each their quota of annoyance. To protect himself from the mistakes of the customer, the overseer will be sure to use for bands twist yarns that will not only be strong, but of such a combination that he could readily identify them. In this mill, the skein bands were made of 16 single filling twist twisted in the double 7, 20 turns per inch.

Aside from the possibility of

A COMPLAINT

being manufactured, is the probability that mistakes will be made. This may be expected of customers who get their yarns from various mills, or from commission houses who sell yarns for various mills. Although in

error, complaint is made in good faith and without a check such as is mentioned above. The complaint will appear substantiated, and an allowance made.

A close scrutiny of yarns received from the spinning room is important, to see that the yarn is not only clean, but free from kinks, and that the bobbins are well wound. Great care should be taken to see that the wet cloths put upon the mule spun yarn are not allowed to stay too long or mildew will result, and yarn be spoiled. Yarns should not be allowed to remain in cloths longer than 36 hours.

TWISTED YARNS

to be reeled are invariably twisted wet, and are already conditioned.

The usual 54-inch reel was used and run at a speed of 150 turns, and was equipped with 50 spindles. The usual production totals are of little value, as they are figured proportional to the number. The following table of averages will illustrate this:

REELING PRODUCTION TABLE.

No. of yarn.	Pounds per 58 h'rs.	No. of yarn.	Pounds per 58 h'rs.
17	1,600	28	1,180
18	1,539	30	1,140
20	1,420	36	1,110
22	1,335	38	1,096
24	1,250	40	1,066
26	1,212	45	1,030
Diamond lease.			
28	800	38	366
30	727	40	640
36	698	45	620

Average earnings per operator, $8 per week.
This table is made up from actual results per 100 spindles.

Take the convenient figures of No. 20s and No. 40s, according to table of reel production. 20s continuous run would give 4,660 pounds in 58 hours; actual production shows 1,420 pounds, or 30 per cent of the continuous run; 40s for the same time would show a 2,330 continuous run, and actual production to this number shows 1,066 pounds 45 per cent of the figured pounds production.

When reeling to the half of the spindles, as in the case where the skeins are made in a diamond lease, the production was cut in half, or nearly so, as the traverse of the guide is twice the usual length. This is done to spread the yarn, and results in the production of a skein which has the appearance of a series of leases, and diamond shape, and unwind in perfect form. No. 237.

CCXXXVIII. DEFECTIVE SYSTEMS.

A line of samples was produced with yarns that were in stock of single 20s cotton mule spun mixes for warp and single worsted yarn for filling. The warp yarn required was to be made lofty and with as little twist as possible.

This line was a very good seller, and there were some very good orders. Mixed cotton yarn was not made in this mill, but had to be bought in the yarn market. Orders were filed with the treasurer for the amount of cotton yarns wanted. These orders were transferred to a yarn agent who, on his part, placed these orders in a mill making the kind of yarn wanted. In all, there were about ten shades. The first delivery was to be of 100 pounds of each shade to enable us to get out the short lengths for the selling end.

On receipt of

THE FIRST SHIPMENT

of yarns the dresser on the Scotch warper was given orders to proceed to dress short lengths. After tieing in his yarns and on starting to run his reel the yarn broke down so badly that he reported that he could not use this yarn.

On testing the above, it was ascertain that there were only 16 turns to the inch of twist, where there should have been 18. The condition of the yarn as referred to above was reported to the superintendent at the main mill office, and was immediately referred to the treasurer, who called the yarn agent's attention to the complaint, on receipt of which, the yarn agent took the matter up with the mill that made the yarn.

After one week the reply was received back through the same channels that a mistake had been made. That the yarn sent was intended for hosiery and

SHIPPED BY MISTAKE,

and that the error had been corrected and shipment of yarn that was going forward was all right. As each case was opened, an effort was made to do some dressing, but it was futile.

About the time the advice mentioned above was received, there had been already delivered about 1,000 pounds of each of the shades ordered. This was reported to the treasurer, and by him to the yarn agent, and forwarded to the mill, the management of which could not understand what was the matter.

Before an understanding was obtained in which all imperfect yarns were to be returned, there were some 56,000 pounds of yarn on hand impossible to use in a warper, and that had to be returned to the spinner.

Throughout these freak negotiations every bit of the yarn that showed any strength was made use of, as we were heavily pressed for the delivery of goods. No. 238.

CCXXXIX. CURTAILED PRODUCTION.

The following is an accurate statement of actual conditions in this mill, and suggests the extreme difficulties that in some mills confront the superintendent and overseers. It covers a period of two years up to the time when the depression of 1907 came along.

The weave room at the time referred to had the following different kinds of looms:

Name of loom.	Number.	Harness.	Boxes.	Reed space.	Speed.
46″ C. dob.	280	20	6×1 4×1	43″	145
46″ C. cams	227			48″	145
50″ C. dob.	281	20		48″	145
60″ Knowles	119	20		55½″	130
64″ K. cams	209			63″	140
82″ Know. F. H.	128	20	4×4	78″	120
62″ Eng. cams	36			60″	130
72″ Eng. cams	24			69″	125
66″ Dra. cam. auto.	240			63″	125
50″ Crompton	2		6×1	48″	130
46″ C. & T.	80			43″	
72″ Know. F. H.	204	16		69″	125
64″ Know. F. H.	46	16	4×4	60″	125
64″ K. cams	24	4	4×4	60″	125
66″ C. T.	98	20	4×4	63″	125
75″ C. cams	24			72″	125
52″ C. jacq. double lift	142			48″	145
52″ C. jacquard	178		6×1	48″	125
48″ C. jacquard	96			43″	125
	2,538				

Also the following qualities on order, each quality with varied styles.

Quailty.	No. of pieces to be woven.	No. of looms on each quality.
3618	4	4
3769	82	12
3778	20	0
3795	741	34
3862	293	62
3867	50	21
3872	409	27
3874	875	169
3878	42	13
3879	81	0
3887	945	40
3891	128	13
3909	4,373	80
3910	316	11
3924	26	15
3940	135	30
3943	15	4
3945	1,601	77
3972	30	8
3977	83	8
3982	6	0
3984	65	7
3987	449	61
3989	156	43
3991	151	20
3993	17	6
3994	932	31
3997	181	14
3998	8	2
3999	122	14
4167	346	0
4170	115	0
6983	184	30
6086	18	1
6093	509	57
6094	224	85
6095	26	2
6097	235	14
6098	22	5
6100	711	31
6102	54	24
6103	2	1
6105	266	31
6107	23	1
6108	20	0
6109	247	2
6110	466	7
7004	55	13

7005	318	40
7009	53	3
7011	53	5
7012	1,443	50
7013	5	9
7014	4	1
7015	78	6
7018	12	7
7023	42	10
7026	60	10
7027	116	15
7028	112	11
7030	45	13
7031	2,279	39
7032	11	0
7038	253	7
7039	202	6
7041	39	6
7043	263	44
7045	73	3
7046	186	2
7047	19	2
7052	193	7
7053	33	0
7054	16	6
7055	134	1
7056	9	4
7057	27	2
7060	10	4
7063	288	12
7064	381	76
7076	120	0

Orders were received at the dressing room for so many pieces without specifying the number of pieces wanted per week or giving a loom assignment. To better appreciate the situation, it is necessary to understand that this mill made yarn for sale as well as for their own weave room, and that they controlled the sale of their cloth and yarns.

A weave room with such a variety of looms and the numerous fabrics called for would need to be thoroughly organized and carefully administered, and the agent and the selling end should endeavor to simplify conditions as much as possible. On the contrary, not only was there no loom assignment, but the selling end at New York from day to day sent in orders calling on the superintendent to put more looms on a particular quality, ordering warps of different qualities to be taken out of looms regardless of what provisions had been made to provide filling or warps to take their place.

The selling end also was

CONTINUALLY INTERFERING

with the spindle assignment for filling. For instance, there were 200 looms with warps taking the same filling. A report was received from the filling room that there was not enough filling coming from the spinning room to keep looms active, and that the stock on hand was going fast. The overseer phoned the spinning room to ascertain what was the matter, and was advised that the spinning room had received orders from Boston that as a particular yarn customer wanted a larger delivery of yarn than he was getting, they were to take off so many spindles of the filling yarn wanted for the above 200 looms, and put these spindles on to make the yarn wanted by this yarn customer.

Complaint was made to the superintendent and by superintendent to the agent and then to Boston. Sometimes under such circumstances relief was given by a reassignment of spindles to keep looms going, but more often, as in this case, the order was to take the warps out of the loom. But before these instructions were received many looms were waiting.

This was no incident, but a condition of

COMMON OCCURRENCE,

and it is a known fact that warps have been in looms and taken out of looms as many as four times in the weaving out of a warp. The bad effect of such management is not confined to loss of production and the extra unnecessary labor, but to the weaver running 2, 3, 4, or 8 looms, who, on finding his loom stopped for filling, wanted to know if he was going to be paid for the time lost, and so to keep the help an allowance was frequently made by the overseer.

This reduced production, increased cost and made accurate cost finding impossible. Was it any wonder that the president would speak of the cloth department of this company as unprofitable, and at times started into doing things, not by rectifyng the conditions referred to above, but by discharging good, capable men who were the victims of these disgraceful conditions above cited, men of ability, who had worked under impossible limitations.

As an illustration of the wisdom shown when the discharging took place, the president called upon the

agent at the mill, and there was a stormy scene in which the proprieties were somewhat forgotten. The superintendent was called in. He was too big a man to permit any indignity or admit he was responsible for conditions created by the selling end, and

TENDERED HIS RESIGNATION.

This was not what was expected, but eventuated in the retirement of the weaver also. The quality of the management's judgment was illustrated in the way they selected men to fill the places made vacant. The superintendent who was appointed had his training in a woolen mill, and previous to this promotion had charge of a wool room for some years, in fact, had absolutely no training or experience of the most rudimentary knowledge of the making of ladies' wear, such as cream lustres, mohair Sicilian, chiffon panama, batiste, voiles, checks, Scotch plaids, alpaca, etc., the fabrics this mill makes.

In the new arrangement, this superintendent was expected to confine himself to the office end of the management, getting out designs, cost accounts, taking care of the orders as they come in, recording the same and ordering yarns forward for warp and filling, regulating the delivery of finished goods, etc. Associated with this man was another superintendent, or boss weaver, who supervised the making of fabrics, the dressing, weaving and the grey room. For this position a man was selected who had absolutely no knowledge of the fabrics made in this mill, his experience being confined entirely to cotton mills, in none of which was he a brilliant success, and when hired, he had been on the waiting list for some time. The advent of this man was a very unhappy experience to all the employes of the department.

Has it ever been the misfortune of any one of our readers to be in a position of responsibility, in which they were thoroughly

VERSED IN ALL DETAILS

under their charge, but had a man put over them who knew absolutely nothing about the work, and who, to accentuate his importance, would be continually interfering with the details of the work, thus making it necessary for you to be continually putting him right when he would show his ignorance of the various processes which you had under your charge? For instance, some yarn from the worsted department came in mixed. One of the bobbins was 2-50s worsted territory wool and the other was 2-32s worsted made of South American crossbreds and pulled wool. When these bobbins were shown to him he said that he didn't see the difference. He had never seen a thin sheet of a cotton warp dressed which was to be filled with worsted lustre yarn cloth for ladies' wear. These warps having been previously hand dressed, he would have it that this process was entirely unnecessary, and would have them dressed as gingham warps by chain beaming and slashing.

With such administrative equipment, is it any wonder that for the last four years this mill has not run more than 25 per cent of its looms, or is it any wonder that the stock of this company is not in demand. Is it any wonder that the president asks why the mills that buy yarn from his plant run their mills night and day, while his own looms are stopped? Is it any wonder that the fine staple fabrics mentioned above are not called for from this company, and instead, almost all orders received are for coarse serges? Is it any wonder that the Atlantic Mill, of Providence, and the Pacific, of Lawrence, have taken up the business of furnishing the market with these fine fabrics to the exclusion of this mill? No. 239.

CCXL. WARPER AND SLASHER RADDLES.

It is the objective point of all bright, wide-awake men in responsible positions to eliminate, as far as possible, the need for nice judgment on the part of the ordinary operator. This was the reason why the new man introduced the saw tooth expansion raddle, trying out this raddle on both slasher and warper carefully and arriv-

ing at definite conclusions as to its value under all conditions.

In these experiments it was proven that this raddle gave a uniform and equal distribution of wires and retained its position at all points to where it was wound, showing desirable rigidity. This can easily be understood when its construction is examined.

SPRING RADDLE.

The ordinary spring raddle is not exact in its distribution, and unless carefully manipulated will produce many defective conditions. It must be well racked out so that the spring will have a certain amount of keenness or the pins will not be evenly distributed, and the yarns will raddle out heavier at one point than another. Even with the spring at its keenest tension, it is always found necessary to aid the wires to equal spacing with the finger and thumb.

If the spring raddle is racked out to a keen point, the variation of adjustment will be very small, and to properly meet this condition, a large variety of raddles should be kept on hand. This is not generally done, and the warper girl has to be continually on the alert to prevent bad work in warping from irregular spacing. Particularly is alertness needed on the part of the operator when the raddle spring is easy in its tension.

UNEVEN RADDLING.

Warpers are large factors in determining the value of the product of the room. If the yarns are raddled heavier at one point than another, that is, if more threads to the inch are spaced to run onto the beam at one point than another, these threads will come off the beam easier and probably sag in slashing. This will give trouble at front raddle producing crossed-up warps and frequently short lengths by reason of smashes caused by the sagging yarn. The yarn may run onto beam slack, but it will have the appearance of coarse yarn in the cloth.

These conditions and many others not mentioned emphasize the importance of a correct distribution of threads through the width of the section beam. To put it concisely, the raddles in general use are not exact, in fact, they require considerable care to prevent what might be called congested or unequal spacing of threads, and the care of these conditions devolves upon the operator, and a higher standard of efficiency is required which is unfortunately not easily obtained. With the adoption of the saw-tooth expansion raddle, the warping problems were lessened to a very large extent, and the exceptional skill required to run a warper was much modified. No. 240.

CCXLI. SAW-TOOTH EXPANSION RADDLE.

A saw tooth expansion raddle, a section of which is shown in Figure 105 is so constructed that an equal distribution of dents to any width is secured. It is entirely mechanical in its action, having no springs with their variableness in its construction.

The body of this raddle E is similar to the ordinary spring raddle, but instead of springs occupying the space in the centre a screw runs the full length. From the centre to the side the screw is cut right and left, on opposite sides. On each side an elongated nut fits on the screw. This nut is so constructed that any section of the raddle may engage it. On turning this screw, which is provided with a handle, expansion or contraction is effected.

CONSTRUCTION OF RADDLE.

By referring to Figure 105, the following description of the construction may be readily understood. A is a high and left hand screw running the full length of the raddle, and controls the spacing of each dent. B is a stud which not only supports metal strips D, but is made of a size to make a close fit of the space occupied by screw A, and extends down in this space to the screw engaging the screw nut, at any point desired. C is the hinge of D metal strips. These metal strips are three-quarters of an inch deep, three-sixteenths of an inch wide and about five inches long, containing 27 pins two inches long, and three-sixteenths of an

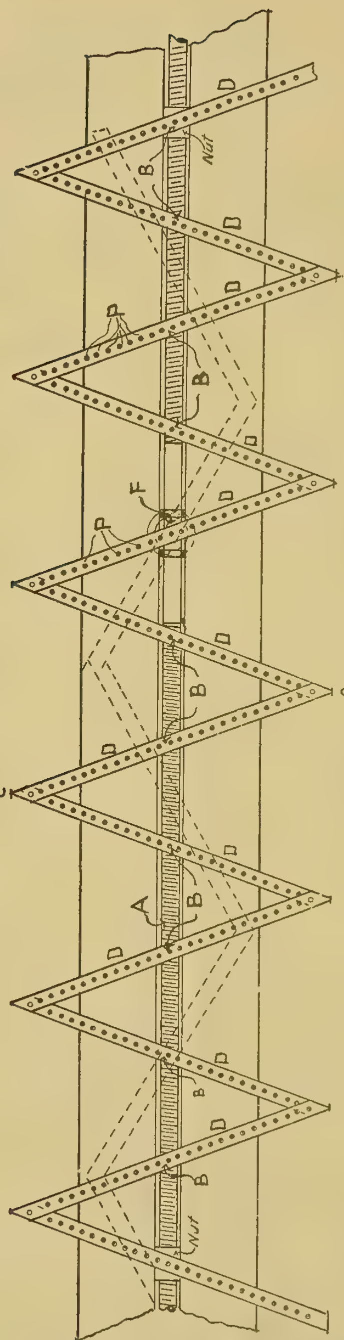


Fig. 105. Saw-Tooth Raddles.

inch apart. This metal strip sets on a support which is an extension of stud B, and acts as a swivel, leaving the strip free to work latterly. F is the centre stud which is fastened to the centre of the raddle, a point of rest from which all expansion and contraction is made.

Figure 106 shows in two positions the metal strips D, illustrating the way strips are fastened together with hinge C. The hinge pin also constitutes a raddle pin equalizing the relationship of all the pins on each and all sections. This arrangement secures a perfect distribution of pins when the strips are at any angle, the limitations of the angle being to a point where the spread can be effected by the screw in expansion or contraction.

The angle of the strips in Figure 105 described above will give a spacing of 863 dents to a 54-inch section beam width. The shadow expansion shown dotted gives a spacing of 343 dents to the same width. To obtain this, the stud B would have to be engaged by a screw nut at a different point, or the raddle would extend beyond the width of the warper, but provision is made that each section can be folded back and will not in any manner come in the way of the operator.

150% EXPANSION.

Exact, equal distribution is not only secured by the raddle, but the extent of its expansion is an exceptional and desirable feature as given above and illustrated in Figure 105. The figures given show a difference of not less than 150 per cent, that is, with the width raddled to the width of a section beam. The spacing would be 863 spaces, or say, threads, to the beam width, and when expanded to retain a convenient angle of each section the spacing is reduced to 343 spaces or threads to the width of section beam, or as has been said before, a difference of 150 per cent.

With a raddle as above described, there is no changing of raddles necessary. It would be difficult to think of a combination of conditions in a mill where there would be greater ex-

tremes in the warping to the number of threads. Even if such an unusual condition should be found where No. 100 and No. 10 yarns were used, they could both be warped on the same warper and every condition could be met, particularly as far as the spacing of the yarn by the raddle to its number is concerned. No. 241.

CCXLII. DRY SLASHER.

In a previous chapter in our "Studies of Mill Management" brief allusion was made to dry slashers. These machines are used to dress warps for looms from section beams. This work is confined to grades of goods taking twisted yarns in the warp, and that do not need to be sized for weaving, such as cotton duck and worsted voiles.

The sets are handled the same as in the wet slasher—so many beams to the set—and when the set is put in, the yarns of each beam are latched onto a leader and pulled through to the front, having strings between the yarns of each beam to provide a line in which the dividing rods in front may be put

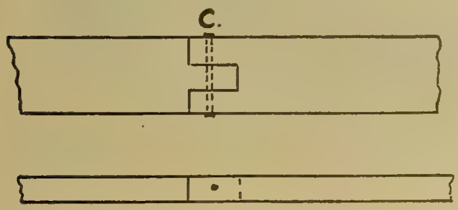


Fig. 106. Metal Strips.

to keep the yarns of each section beam separate. These rods continue in their respective position during the running out of the whole set.

The raddle is struck in the same manner as on the wet slasher. After the threads have been spread to their normal section beam width, the raddle is brought up from under the sheet (warp). The spacing of the raddle wires is done to provide for expansion or contraction as desired, each wire separating the yarns in groups. These groups should all contain the same number of threads all the way across the sheet.

POOR SLASHER MAN.

The ability of the operator is indicated by the way he strikes his raddle. A poor slasher man will always have to spend a good deal of his time in transferring threads from heavy to light groups to obtain an equal distribution of warp yarns, so that the loom beam will wind on the yarns uniformly, and this cannot be done if the threads are not spaced off properly to the full width.

The measuring is done by a back roll around which the warp passes, and is made to hug the measuring roll to half of its circumference by being bent inward through having to pass around a roll before reaching the measuring roll. This prevents the possibility of slippage, and secures accurate measurement. The clock is a chain clock, each link of which represents one yard, and each link can be put on or taken off with ease and facility. A raised link uplifts the lever that operates the cut marker, and there is also a dial that indicates the number of cuts as they are run onto the beam.

As a general rule, a dry slasher meets every condition satisfactorily, but there are warps wanted which take twist yarns which do not warp on at a uniform tension. To equalize the tension of the yarn before reaching the loom beam the big wet slasher is frequently used, as it provides a much longer stretch of yarns between section beams and loom beam.

UNIFORM TENSION.

This is satisfactory as far as it goes, but the yarns are not quite free enough as they pass around the cylinder to make adjustments of the individual tension of each thread. To remedy this defect it is recognized that a long reach between beams must be provided to allow each thread to properly adjust itself by equalizing its tension, that is, the thread at its tight places will draw on the slack places when they are free within the length or reach.

The importance of having warps in which the tension of each thread is uniform is exceedingly great, as it will, in a measure, determine the value of the fabric woven. Reputa-

tions have been built up by close attention to just such matters. The fabrics referred to are heavy duck sail and tire cloths that primarily require strength, and a slack or tight thread is just so much weakness in the cloth.

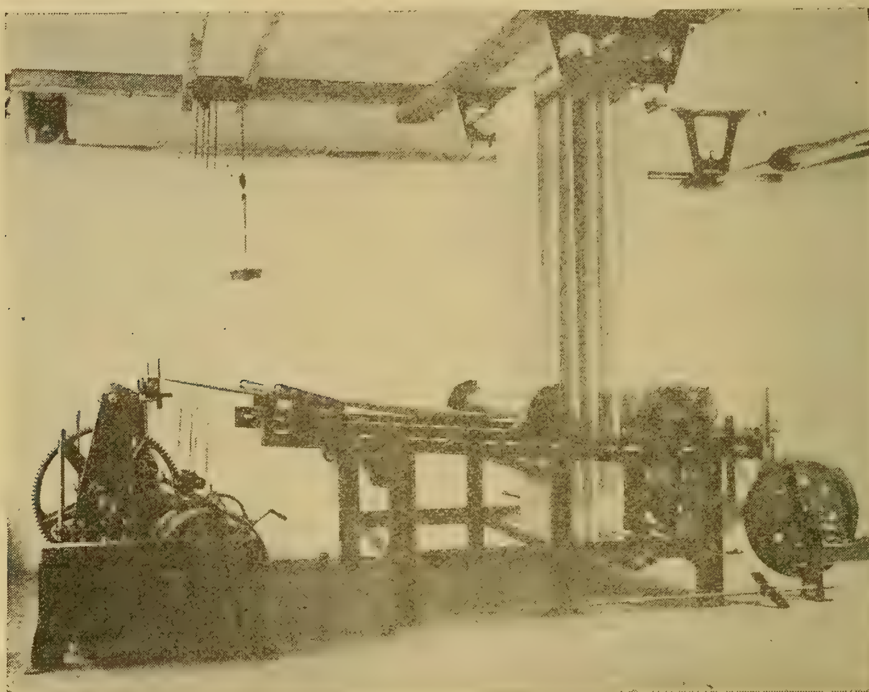


Fig. 107. Improved Dry Slasher.

To meet this condition and to secure an evenly balanced warp, an improvement has been effected on the dry slasher whereby a long reach is secured without taking up any extra floor space. A dry slasher with this arrangement is illustrated in Figure 107. This slasher provides for six extra reaches, and one more could be arranged for, and the length of the reaches will only be limited to the height of the ceiling.

This machine is capable of meeting all the objectionable conditions referred to above, and produces a warp for the loom which has each thread of an even tension all through its length. No. 242.

CCXLIII. CHAIN WARPS IN THE DYEHOUSE.

In preparing chain warps for the dyehouse, whether they are intended to be colored, bleached, mercerized or only sized, it is necessary to consider not only the requirements of the fabric in number of yarn, grade, threads and length, but the conditions under which the chain warps shall be handled in the dyehouse, not only in regard to economy of costs in the process, that is, saving of dyestuffs and labor time, but also in regard to results obtained.

It is too often apparent that if the warps sent to the dyehouse had been prepared differently there would have been much better results from the work done. This is in the face of the fact that where chain warps are used either in hand dressing or chain beaming, there is provided all the

necessary facilities to meet almost every condition.

CHAIN DYEING.

To make clear to the reader the condition in the dyehouse that compelled the dressers' consideration, we will describe the usual chain warp dyeing machine, so far as it concerns the dresser. (See Figure 108, which is a section of dyeing machine).

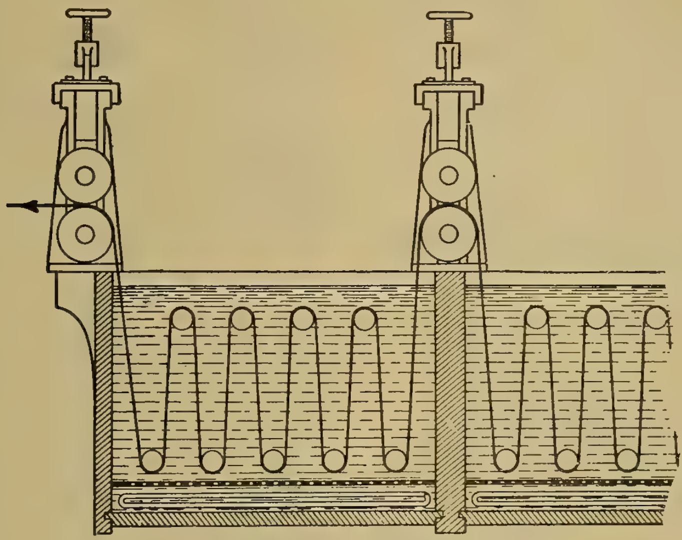


Figure 108. Dyetub.

This machine can be used for both long and short chains. The difference in the processes is that in the operation of dyeing short chains the solution is prepared to complete the coloring of the warp, whereas the coloring of a long chain of, say, 9,000 yards requires constant feeding of dyestuffs to the liquor or bath.

This machine is suitable for both dyeing, washing, sizing and what is called boiling out. Of course, bleaching and mercerizing have their special machines. Boiling out is always done as a preparation for practically all dyehouse processes, therefore, the conditions are the same in all processes when preparing a set.

Warps are usually run into the machine in four strands, each strand containing one or more warps. If the strands are all of the same heft—bulk or weight—they will enter the feed rolls and pass down to the bottom, up, over and under the whole series of rolls, and if every other condition is met, the warps will reach the dressing room in good shape.

UNIFORM STRANDS.

If the dresser should send warps to the dyehouse in such a manner that a combination could not be made to have each strand of a uniform heft, the warps as they ran through the machine would not have a uniform tension. The small strands would bite the feed and squeeze rolls less proportionately to their relative smallness, and as the larger strands would spread the rolls apart, greater space between the rolls would be provided than small strands would occupy. Neither the feed nor the squeeze roll would control or regulate the tension of the small strand, and these conditions are likely to produce badly broken warps, as a slack strand is very likely to get tangled on one of the rolls, and not infrequently torn apart.

Sometimes a warp containing a

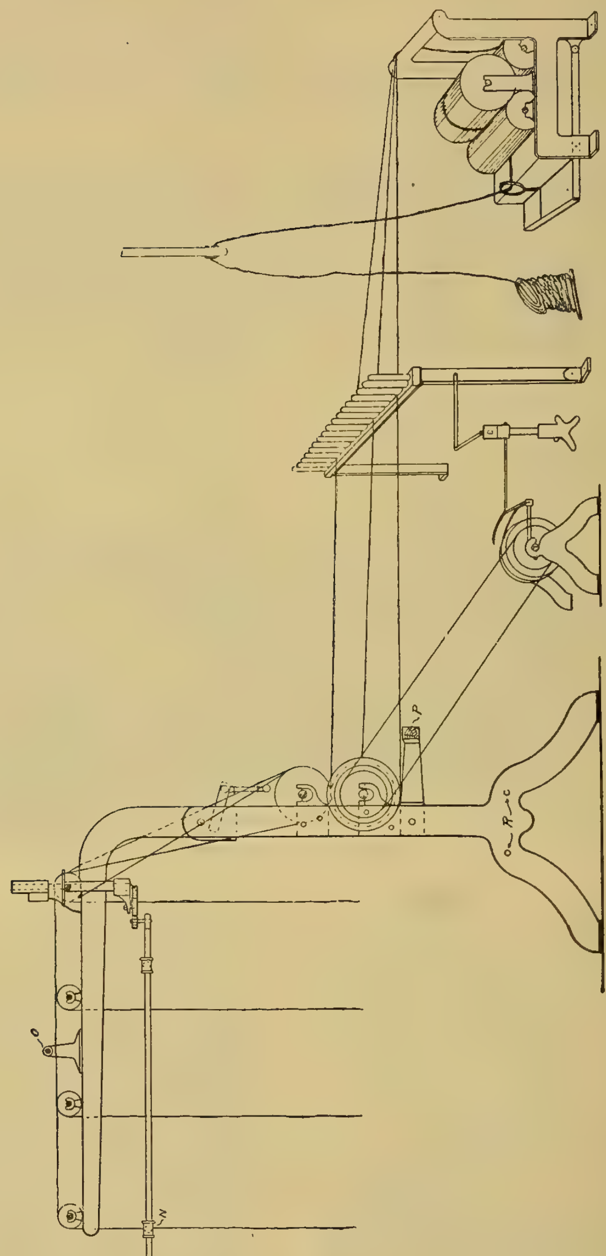


Figure 109. Splitter.

small number of threads, say, 120, is to be dyed. It does not matter how it is handled in the dyehouse, the probabilities of its getting torn are great, even if the strand to which it is attached is the same weight as the other strands of the set. This small bit, as it is usually called, will run in tight regardless of every precaution taken, and it will be strained and have at least many

BROKEN THREADS.

Threads broken in a dyeing machine are prone to get tangled around the carrying rolls, and if the warp is small it will sometimes break the whole warp and wind it all onto the roll. If this occurred to a large warp, the ends would ultimately reach a lease and break away. We are aware that if there was a string around each strand the bad effect would be minimized but to a small extent. These conditions, with many others of a similar nature, are too common, are no end of trouble and inexcusable. As we have said before, every facility is provided to enable the overseer to steer his work clear of such trouble.

We admit that there are unusual conditions when a small warp or bit is to be colored. but it would be far better to double this as a skein. What we are particularly referring to is a circumstance which requires a piece to be colored to make up the balance of threads which are short to produce warps of a particular style. If for hand dressing, it is best to dress it into the warp it is intended to go with in the grey. No. 243.

CCXLIV. METHOD OF WARP ASSIGNMENT.

When the overseer of the dressing room proceeds to provide chain warps for a particular style, he makes his combination from warps available in stock, giving due regard to all conditions, including the convenience of the dyehouse. Suppose these styles called for 2,500 threads of 1-50, and the available warps on hand were two warps of 1,800 threads, two warps of 1,600, one warp of 1,500, one warp of 1,000, and one of 700, the combination for the dyehouse would be three strands. First and second strands. one warp 1,600, one warp 1,800 and third strand warps containing 1,500, 1,000 and 700. This combination would give four warps of 2,500 threads, and when returned from the dyehouse the warps would be counted and split as follows: 1,000 plus 1,500 equals 2,500; 700 plus 1,800 equals 2,500; 700

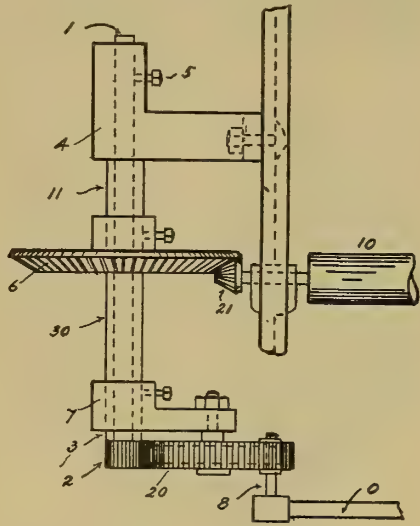


Figure A. Coiler.

plus 1,800 equals 2,500; the remaining 1,800 thread warp split in two 2-900. Two combination, 900 plus 1,600 equals 2-2500 threads; in all 4-2500 threads.

There are many much more complicated combinations than the above, but there need be no difficulty in arranging them, and in providing the best conditions for all concerned, where there will be neither small bits nor unequal strands to bother the dyehouse, and the dressing room will get warps in best form under the circumstances. One feature must always be kept in mind when preparing warps for the dyehouse, they must not be too large. It is safe to say that a strand would be all right if it did not exceed one and one-half ounces to the yard.

SPLITTING MACHINE.

A splitting machine is indispensable to both chain dressing and quill-

ing departments. The conditions under which the dressing room is called upon to work are to be found to a similar extent in the quilling room, perhaps more so, as all chain warps to be quilled contain only 378 threads, and consequently, more splitting to the pounds quilled than to the pounds warped.

By referring to Figure 109, the reader will more easily understand the following description of a splitter. This machine consists of three prin-

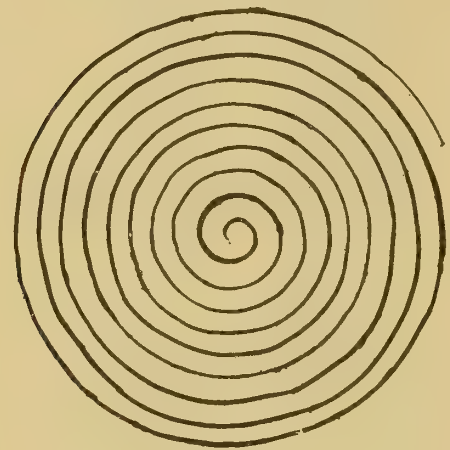


Figure B.

cipal parts, namely, friction rolls, rocking separator and the main frame, which contains the driving mechanism. The chain warp to be split is on the floor under an overhead eye bole, through which it passes, and from which it proceeds through a guide found in front of the friction stand and under the first, over the second and then under the third friction roll and then over a carrying roll to the separator, which is equipped to divide a chain into 24 parts, each part separated, then passed under one of the six rolls, resting on bottom rolls which carry the warp forward. Overhead in the same frame, there are four separate driven rolls, over which each section chain is carried, passing to the floor through pot eyes fastened to a frame which has a guiding motion describing a circle, each chain running onto a separate pile.

The operator stands beside the separator by which he starts and stops the machine. The separator is connected with the shipper and when the separator is carried forward, it ships the driving belt onto the loose pulley. This arrangement acts as an automatic stop motion, should the warp come up tangled.

DEFECTIVE PILE.

One defect of this machine is the way the chains are piled when they reach the floor. The guide describes a continuous circle, and as it piles, the walls it forms cave in and tangle the warp. We have heard of several devices invented to remedy this defect. The best that has come under our observation is the device as illustrated by Figure B. This coiler, as it is called, forms layer after layer, producing a compact mass. (See Figure A.) This device is described as follows:

There is a long steel stud, No. 1, running from the top to the bottom of the coiler, on the lower end, a gear No. 2, is cut, and on top of gear is a coiler No. 3, pinned to said stud. Over stud,

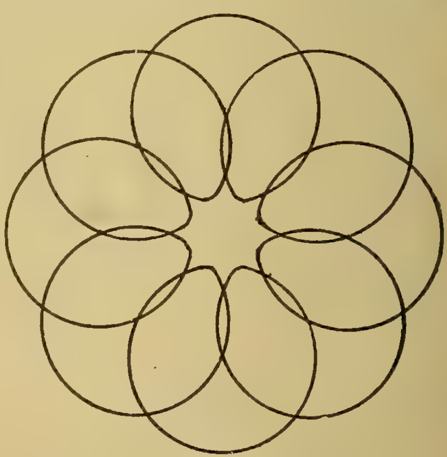


Figure C.

No. 1, a brass pipe is placed, No. 30, as far up as casting No. 4, where stud No. 1 is fastened by screw No. 5, and gear No. 6 is screwed to pipe No. 30, also casting No. 7. On the end of casting No. 7, there is hung a large gear No. 20, said gear meshing with gear No. 2. Near the rim of gear

No. 20, there is a stud, No. 8, which guides the pipe frames with the pot eyes No. 9. Now when roll No. 10 starts this turn pinion, No. 11, thereby causing all of coiler motion to revolve round stud No. 1, and gear No.2, which you will remember are stationary, as it turns, it is obvious that stud No. 8 will work over to gear No. 2. Sketch shows stud No. 8 on the outside, at which point it is traveling in its widest circle, but as it gets nearer No. 2, it grows smaller, and when it passes gear No. 2, it is traveling in the smallest circle.

COMPACT PILE.

As stud No. 8 guides the pipe with the pot eyes, you will readily understand that the yarn will be placed on the pile in exactly the same circles as made by stud No. 8, revolving all the time in the same direction, but gradually working from the inside to the outside of the pile, and then back again, etc., thereby making a solid and compact pile.

Changing the position of gear 2 and 20, and adding to stud No. 8 a crank half the length of the large gear's diameter, an entirely different coil can be produced. (See Figure C.) In coil illustrated, there are eight inner coils within the circle, and by changing the gearing, the layer of chain warp could be made to occupy a different point within the circle of the pile at each revolution. It has been claimed that where these coilers have been used, an unusually large saving has been effected in quilling, as the warp leaves the pile at all points perfectly free, and not a thread is disturbed or out of place. The mechanism is simplicity itself, and also adjustments can be made as may be desired. No. 244.

CCXLV. TUBE WINDING.

In substituting tube winding for spooling in the preparation of yarn for warping, there is one feature that will attract the immediate attention of those who are in charge of the department, that is, the importance of having all tubes of a uniform size and weight and containing as near as possible the same yardage.

The pieces tied out from a warper when tieing in a new set are usually returned to the spooler, and are filled up with the same kind of yarn they contain. This, in the case of yarns standard to the mill, will be repeated in most spools numerous times during a number of years. This practice is a matter of convenience, and results in more knots getting into the cloth than if this practice could be avoided, that is, if the spools could be entirely run off.

The tube wound on the winder when tied out of the warper creel, cannot be again conveniently filled up. The probabilities are that the traverse of the guide of the spindle on which it was first wound will have a different adjustment than the spindle you wish to refill it on, and will probably guide the thread over at one end of the tube, that is, run over, and when warped down to this point, the tube would give trouble to the operator. We are perfectly aware that the winding of the tube tends to spread the bottom layers of yarn, but the

CARE REQUIRED

in putting on a piece would need more skill than can be secured from the ordinary operator.

Conceding the feasibility in practice of filling up small pieces, it would be impossible to fill up pieces that were of any great size, and this brings us to the method adopted in this department to overcome this difficulty by securing tubes of a uniform size.

The usual practice is to provide a stick about six inches long. For about four and one-half inches of its length, this stick is one and one-half inches thick, and a notch is made at this point by cutting away one-half an inch of its thickness to the end of the stick. The operator uses this stick to gauge the size of the tube by resting it upon the paper tube on which the yarn is wound. When the yarn measures up to the notch, the tube is considered full, but seldom are the tubes of uniform size, and most frequently, they are too large.

To meet this condition, a casting was made and fitted on to the cone arm of each spindle. On this casting was fitted a wheel or disc, and in such a position that when the tube was of the proper size, it would touch the disc, and cause it to rotate. This disc was painted half black and half white, and was

EASILY SEEN

by the operator, who was expected to stop the spindle and take off the completed tube. This contrivance was a great convenience, and at the time, relieved the difficulty which had given much concern.

In addition to the advantage secured with reference to smallness of pieces, the unformity of the tubes obtained made it possible to make a larger tube. The space allowed each tube in the creel is what determined the limit of the size of each tube—with uniform tubes a clearing was secured for each tube of a larger size, otherwise the large tubes were tied in next to the unusually small tubes to get a clearing. This was the cause of time being wasted in the rearranging of the tubes in the creel.

Although the size indicator mentioned above gave relief, it did not prevent the operator from making mistakes. Subsequent to the above, the Foster Machine Company, which are the makers of the winder referred to above, got out a size stop motion. This device acting automatically, eliminated the possible error of the operator.

This device, Figures 110 and 111, is a very simple attachment. No. 6, the size adjuster, swings on a centred stud, and is weighted in the rear of the centre. On depressing the point of the adjuster, it causes No. 7 catch to release No. 8 drop, which engages the rocker, and stops the winder by throwing the spindle up off the drum. The size adjuster is depressed by a projection on the ratchet handle. This depression takes place when the tube is full. The ratchet bar is attached to a lever, which in itself forms a fixed part of the cone arm, and is held in place by the tube yoke No. 3, on the stud of which the whole arm works freely.

ADJUSTMENTS EASILY MADE.

By referring to Figure 110, which is an illustration of the relation of the parts when the winder is winding, you will note the position of the handle and ratchet bar, also the size adjuster. The adjuster is free, and the relative catch engaged. The handle of the ratchet arm is not in contact with the adjuster. By referring to Figure 111, the position of the above parts are changed. The projection on the ratchet handle has depressed the adjuster and released the relative catch and stopped winding. This is effected by the position obtained through the tube in the winding. Having attained a given size, a tube of practically any size can be made, and adjustments are easily arranged.

The practice of returning the pieces tied out from the warp creel to the spooler referred to above has several bad features, and in addition to the accumulation of knots on each spool, there is the probability of yarn getting mixed. It is also not only possible, but probable, that most spools will not be emptied in many years, and not only will the yarns become mixed in numbers, but also in the stock used in the making of the yarn that was first wound on the spools.

These features are well known to the overseer of dressing, and most all of them wish that each spool could be emptied each time before being filled again, but the difficulties that are in the way seem insurmountable. For instance, in rewinding pieces from spools, the tension on the yarn is very great, and this strains the yarn and weakens it.

In mills which buy their yarn on spools, as in this mill, all spools have to be emptied, and it is recognized that at least 10 per cent of all yarns bought on spools have to be rewound. This does not mean that there is 10 per cent of yarn left on each spool, but includes the repeated rewinding that takes place before the yarn of

each tie-over is completely exhausted. For instance, in a warper set of 500 spools, the pieces of a tie-out will, on being re wound, make at least 50 full spools. These 50 spools will have to go in the creel again, and the pieces left will have to be rewound again. Fifty of these pieces will be larger, as they were rewound with a keener tension than when first wound, and on rewinding, there will be at least ten spools of the original set to go back in the creel. By following the

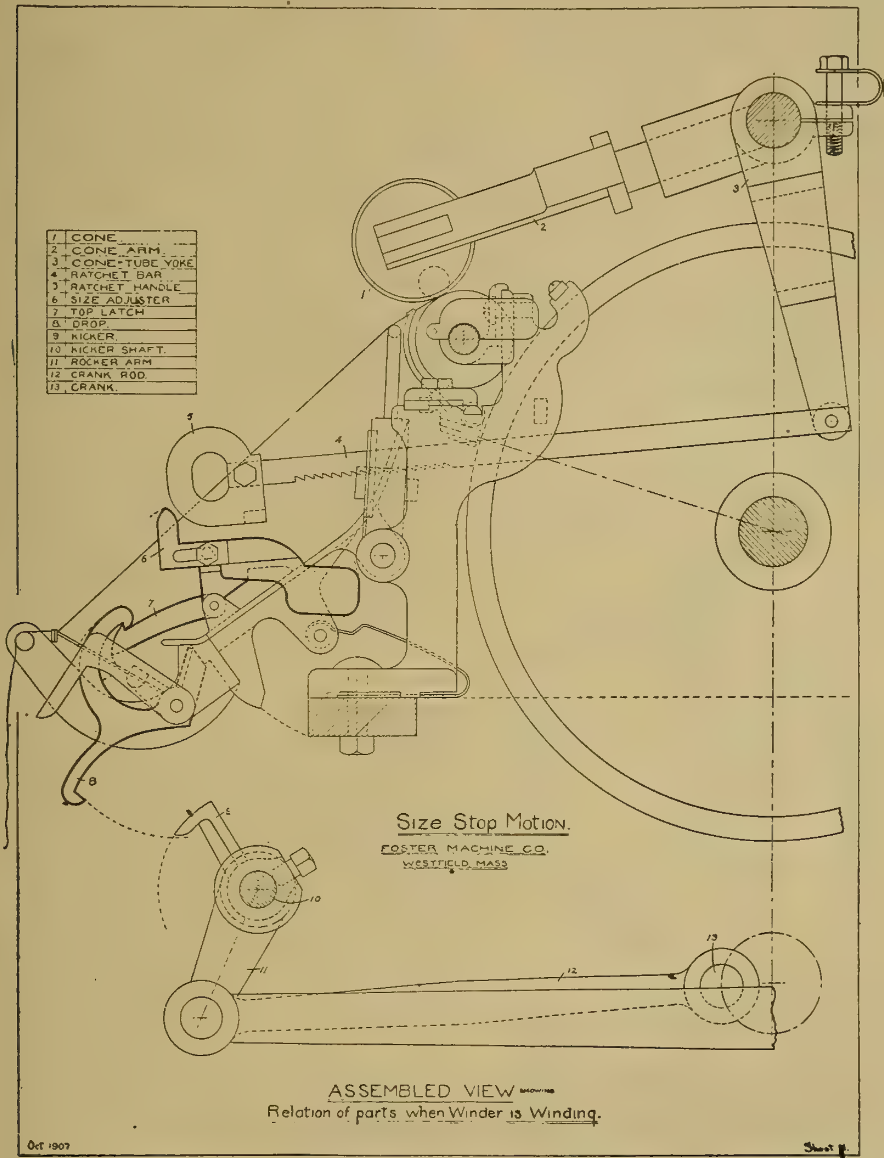


Figure 110.

course of these spools, it is further suggested how much the yarn is likely to be impaired by the repeated re-winding from spools, and the expense, which will not be less than twice the original cost of spooling.

These difficulties are not found when taking care of pieces from the tube—a tube runs off as free when set up on end as a mule cop, and at no greater expense than at the first winding. When considered in relationship to the fact that a tube of a size to occupy the same space in a warper creel as a spool will hold nearly twice as much

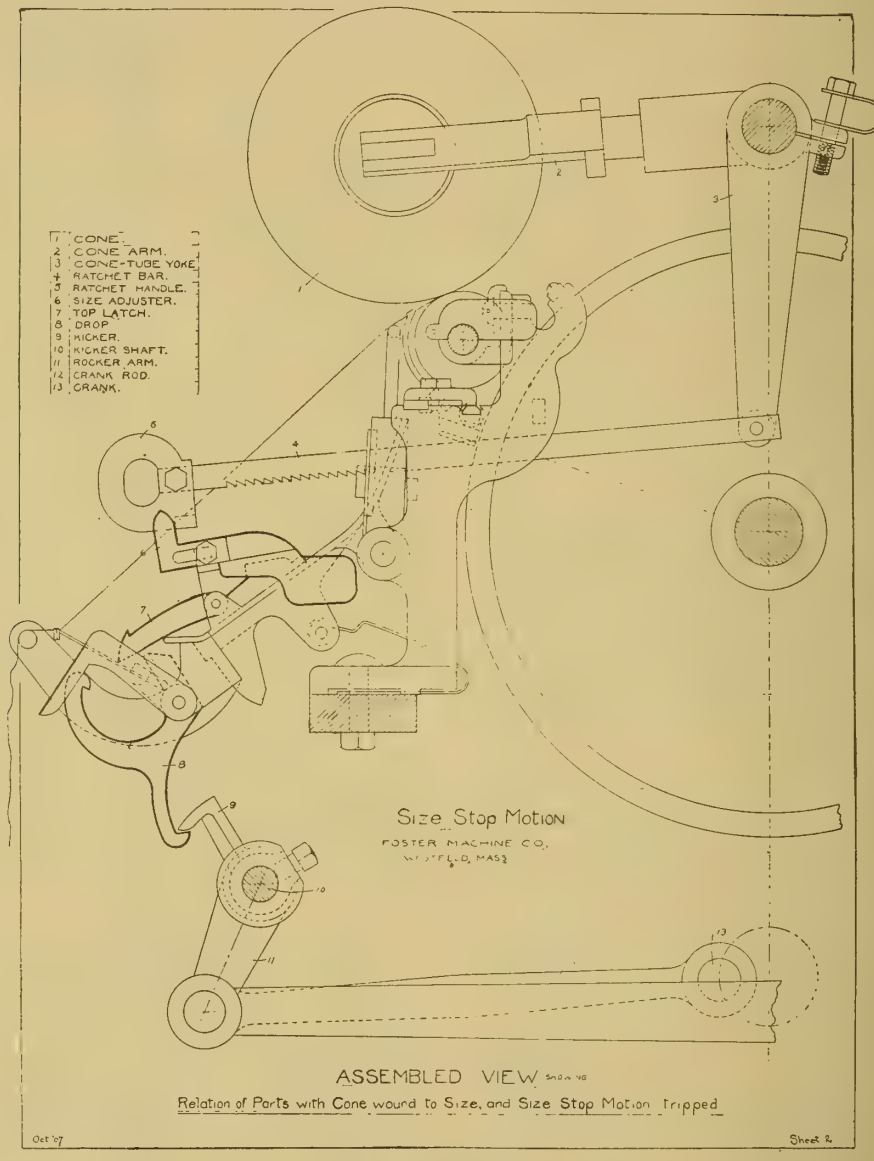


Figure 111.

yarn, it may be readily understood the great advantage in using tubes in warping in preference to spools.

Warping from tubes has not received the consideration it is entitled to. This method of warping has the following features to its credit. Warping is done at double the speed with an easier uniform tension from tubes throughout the unwinding of the whole length of yarn on tubes, and contains twist as must yarn as on spools of the same size. There are no heads on tubes to break, and consequently, no waste of yarn in that direction. The economy in space required to carry the yarns in transit is large. Wooden tubes themselves take up but little room.

One of the features that will particularly commend tubes to mills running on extreme numbers is the easy tension with which they unwind, there being no reason why the same size of tubes should not be used for yarns as low as the coarsest numbers required, or as high as the finest, say, from 7s to 120s. No. 245.

CCXLVI. TWISTING DEPARTMENT.

The series of articles now running in the American Wool and Cotton Reported are intended to cover all phases of work in the textile mills. In the earlier articles, the attention of the reader was particularly directed to the various defective conditions of machinery and process work. Conditions were specified and suggestions offered how to remedy the defects and improve on methods. In the later articles, the writer has taken up the administrative side and on leaving the dressing room will direct attention to the twisting department, which is closely allied to the dressing room, and will describe how the new man took up the lines laid down by his predecessor.

The twisters were Fales & Jenks and were in two separate rooms with two lines of shafts having different speeds. There were also various sizes of pulleys on the line shafts that were used in twisting the various numbers, taking from 5.75 to 27.04 twist per inch.

SIMPLIFYING THE WORK.

To simplify the work as to assignment, Table 1 was drawn up, the first column of which is the serial number to 15, each of which is a different combination of pulleys. The second column is the shaft speed, the third column is the diameter of the various pulleys on the main shaft, the fourth column is the diameter of the three-change cylinder pulleys, the fifth is the spindle speed on each combination, and the sixth is the roller constant to each combination. By dividing the constant with the numbers of twist per inch, the roller speed will be ascertained, and by dividing the constants in column seven, the yards production per spindle will be obtained.

TABLE 1.

1.	2. Main shaft speed.	3. Pulley diam.	4. Cylinder pulley.	5. Spindle speed M.	6. Roller constant.	7. Spindle production constant.
1	475	26	10	6918	1466	11250
2	475	18	10	4788	1016	7960
3	475	24	10	6384	1353	10640
4	475	23	10	6118	1297	10196
5	575	25	10	8000	1700	13333
6	475	26	12	5765	1221	9610
7	475	18	12	4000	846	6666
8	475	24	12	5320	1127	8866
9	475	23	12	5100	1080	8500
10	575	25	12	6666	1416	11110
11	475	26	14	4940	1047	8233
12	475	18	14	3420	725	5700
13	475	24	14	4560	966	7600
14	475	23	14	4370	926	7283
15	575	25	14	5714	1215	9523

By means of Table 1, the assignment of the lots to be twisted was intelligently accomplished. The table was figured out as follows: Taking the first combination, the diameter of pulley is 26 inches. This, multiplied by 3.1416 equals 81.68 inches of circumference, and multiplying this by the speed of the shaft 475 revolutions, we get 30,798. This, divided by the circumference of a 10-inch cylinder pulley 31.41, equals 1,235. These figures multiplied by 22 the circumference of a 7-inch cylinder equals 27,-170. This latter figure divided by 3.9, the circumference of 1¼-inch

whorl, gives a speed of 6,918 inches per minute, and multiplied by 60 equals 415,080 inches per hour. These inches dividend by 36 equal 11,250 yards per hour. By dividing by 4.71, the circumference of roller, 6,918, inches per minute equals 1,469 roller speed constant.

The twisters were all of the same make with four different equipments. All of these were built for twisting wet or dry with this winding motion for filling or warp. The four kinds of frames were equipped as in Table 2.

TABLE 2.

Spindles.	Ring.	Lbs. on each bobbin.	Lbs. per set.
300	1⅞	.1	30
194	1⅞	.1	19.4
128	2 3-16	.1875	24
102	2¾	.4375	44.6

The first column is the number of spindles, the second column diameter of ring, third column the decimal fraction of pounds on each bobbin, and the fourth column pounds per set. These two last columns were important in this mill, as each order for twist yarns was very small, and care had to be exercised to keep a check on pounds twisted to avoid error in making too much or too little yarn.

No. 246.

CCXLVII. GEARING OF TWISTS.

To promptly meet the various small orders referred to in the preceding chapter, a table of standard twists to the numbers of 2-ply yarns used was drawn up, as in Table 3.

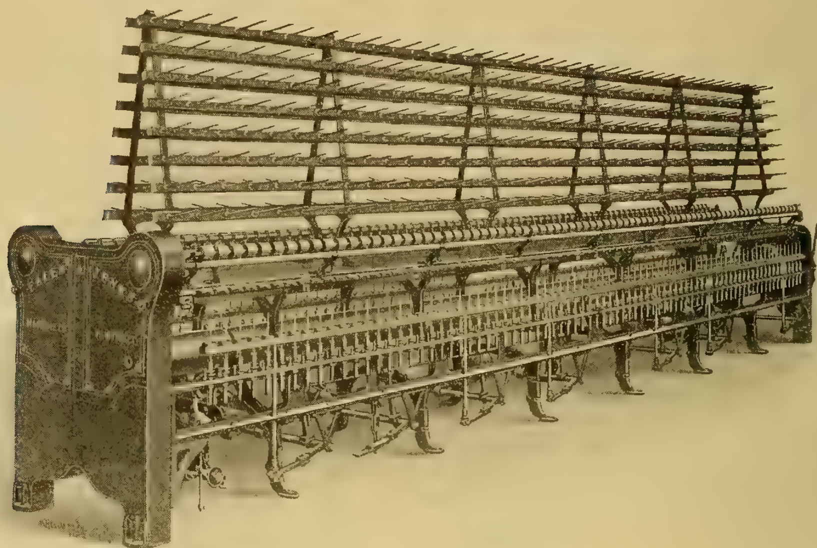


Fig. 112. The Twister.

TABLE 4.
Front roll 1½ in.
Whorl Dim. 1¼
Cyl. Dim. 7.

J. gear, 80; cyl. gear, 30, twist gear.		J. gear, 112; cyl. gear, 24, twist gear.	
6.24	52	10.92	52
6.36	51	11.13	51
6.49	50	11.36	50
6.62	49	11.59	49
6.76	48	11.83	48
6.90	47	12.08	47
7.05	46	12.35	46
7.21	45	12.62	45
7.38	44	12.91	44
7.55	43	13.21	43
7.73	42	13.52	42
7.91	41	13.85	41
8.11	40	14.20	40
8.32	39	14.56	39
8.34	38	14.94	38
8.77	37	15.35	37
9.02	36	15.77	36
9.27	35	16.22	35
9.54	34	16.70	34
9.83	33	17.21	33
10.14	32	17.75	32

10.47	31	18.32	31
10.82	30	18.93	30
11.19	29	19.58	29
11.59	28	20.28	28
12.02	27	21.03	27
13.48	26	21.84	26
12.98	25	22.71	25
13.52	24	23.66	24
14.11	23	24.69	23
14.73	22	25.81	22
15.45	21	27.04	21
16.23	20	28.39	20
17.08	19	29.89	19
18.03	18	31.55	18
19.09	17	33.40	17
Constant	324.50	Constant	567.87

Also the selection of suitable gears was simplified by using Table 4:

TABLE 3.

	Under-wear twist. 3	Hosiery twist. 3½	Under-wear twist. 3¼	Merc. 4	Warp. 5	Thread. 5½	Thread. 6	Lisle. 4½	Square. root.
10	6.71	7.83	7.27	8.94	11.18	12.30	13.42	10.06	2.2361
11	7.04	8.22	7.63	9.38	11.73	12.91	14.07	10.55	2.3452
12	7.35	8.57	7.96	9.80	12.25	13.47	14.70	11.02	2.4495
13	7.65	8.92	8.29	10.20	12.75	14.02	15.29	11.47	2.5495
14	7.94	9.26	8.60	10.58	13.23	14.55	15.87	11.91	2.6428
15	8.22	9.58	8.90	10.95	13.69	15.06	16.43	12.32	2.7386
16	8.49	9.90	9.19	11.31	14.14	15.56	16.97	12.73	2.8284
18	9.	10.	9.75	12.	15.	16.	18.	13.	3.
20	9.49	11.07	10.28	12.65	15.81	17.39	18.97	14.23	3.1623
22	9.95	11.61	10.78	13.27	16.58	18.24	19.90	14.92	3.3166
24	10.39	12.12	11.26	13.86	17.32	19.05	20.78	15.59	3 4641
26	10.82	12.62	11.72	14.42	18.03	19.83	21.63	16.23	3.6056
28	11.22	13.09	12.16	14.97	18.71	20.58	22.45	16.84	3.7417
30	11.62	13.55	12.58	15.49	19.37	21.30	23.24	17.43	3.8730
32	12.	14.	13.	16.	20.	22.	24.	18.	4.
34	12.37	14.43	12.40	16.49	20.62	22.68	24.74	18.55	4.1231
36	12.73	14.85	13.79	16.97	21.21	23.33	25.46	19.09	4.2426
40	13.42	15.65	14.53	17.89	22.36	24.60	26.83	20.12	4,4721
45				18.97					4.7431
50	15.	17.50	16.25	20.	25.	27.50	30.	22.50	5.
55	15.73	18.35	17.04	20.98	26.22	28.84	31.46	23.60	5.2440
38	13.08	15.26	17.44	17.44	21.80	23.97	26.15	19.62	4.3590

In the table of gears, Table 4, every twist used in this mill is provided for with a graduation of twists from 6.24 to 33.40 per inch. If an order was received, either specifying the yarn twist, the square twist or twist per inch, and all customers have their own ideas in this direction, Tables 3 and 4 will meet all requirements.

REFERENCE TO TABLES.

If an order was received for 20-2 mercerized twist, by referring to column 5 Table 3, the twist indicated there is 12.65 per inch. Gearing, Table 3, second column, will give jack gear 112, cylinder gear 24, twist gear 45 and twist per inch 12.62. If the specification as to twist in this order should call for square four, the twist and gearing would be the same. If number of twist per inch was specified, then reference is confined to gear table, Table 4, where the most suitable gear may be selected.

Orders on twisters for pounds were transferred from the order book to a card in the following form, Table 5:

TABLE 5.

TWISTERS NUMBER.

Number.	Kind.	In.	Order.
40/2	C.P.	Skein	2228
□ 5.5	Turn 24.59	Actual 24.69	
J. Gear.	Cy. Gear.	Tw. Gear.	Traveler
112	24	23	16
Sets.	Lbs.	Lbs. ord.	Spdl. speed.
42	24	1,000	6
Made for————		Date————	

This order is for 40-2 combed peeler to be shipped in the skein on 2228 order. By referring to table of twists —5.5 as the multiple of the square root of the number 24.59, the nearest twist to be had by gearing is 24.69, jack gear 112, cylinder gear 24, twist gear 23, and traveler used No. 16. As there are 1,000 pounds ordered and as each set from the twister averages 24 pounds 42 set 1,008 pounds, these yarns are twisted serial number 6, Table 1. (See Chapter 246.)

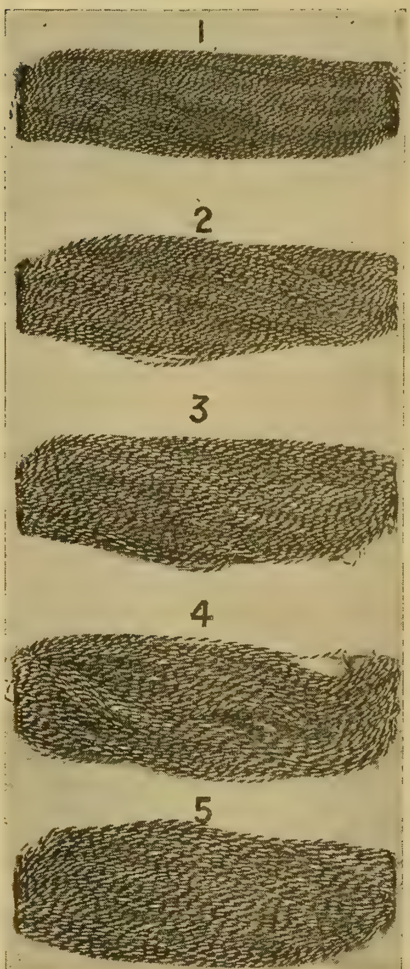
On nearing the completion of this order, when there are still five or six sets to do, which information may be obtained from back of card, Table 5, each set being checked off as it is doffed, the second hand reports for a tally, and a checking of pounds reeled will be made. By this means, the balance required can be ascertained and made to almost the net pounds, preventing too much yarn being

made, and also providing a record on this order in detail of the making of these yarns which will insure a correct repeat of this order should it be called for. No. 247.

CCXLVIII TWIST STANDARDS.

The limit of twist that a given number of yarn will take is determined by its diameter.

To ascertain the diameter of a given number of cotton yarn extract the



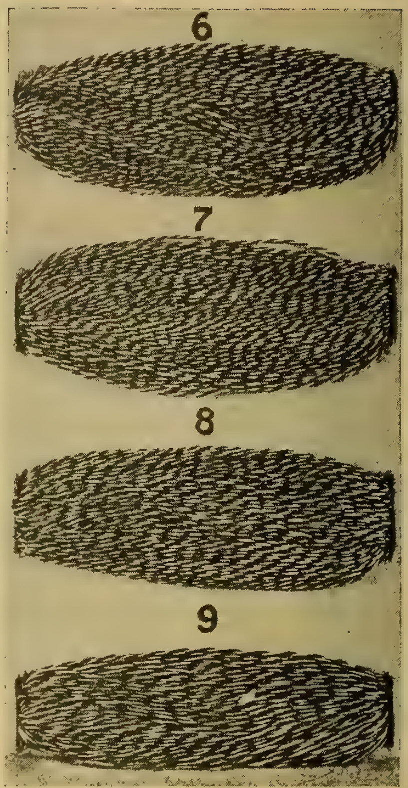


Figure 113.

square root of yards to the pound. For example, 6s.

$$6 \times 840 = 5{,}040 \text{ yds.}$$

$$\sqrt{5{,}040} = 71 \text{ threads.}$$

These threads will sit side by side in the space of one inch. One-fourth ($\frac{1}{4}$) of the diameter will give the limit of twist.

In specifying the twist required in a given number of yarn, figures are used. These figures are used as the multiple of the square of the number and indicate exact twists per inch. The standard which these figures represent is known by names such as underwear □ 3, filling □ $3\frac{1}{4}$, hosiery □ $3\frac{1}{2}$, mercerizing □ 4, lisle □ $4\frac{1}{2}$, warp □ 5, thread □ 6.

The accompanying samples illustrated in Figure 113 are of twisted yarns made from 2/38s C. P. twisted

as described. The single yarn has a twist to □ 5 in all cases.

LIMIT OF TWIST.

Sample 1. This illustrates the limit of twist □ 7.2, 30.83 turns to the inch, and shows the black and white running at an angle of 45 degrees. This twist is not commonly used. The writer knows of only one fabric that requires so much twist to be put in the yarn and this is French voiles, a worsted line of goods. The sum of the multiple of □ 7.2, multiplied by 4, gives the diameter of the number of yarn.

Sample 2. Sample of yarn, twisted 25.81 twists per inch, illustrates the standard of thread twist used in the making of sewing thread, which is □ 6 and figures 26.15.

Sample 3. Sample of yarn, twisted 21.84 twists per inch, illustrates the standard of warp which is the □ 5 and figures 21.80. This is the most uniform thread of all these illustrations as the single is twisted to the same □ number as the twisted thread. This indicates a principle which expediency overrules. This warp twist standard is not universal. The various goods require a diversity of warp standards.

Sample 4. Sample of yarn, twisted 19.58 twists per inch, illustrates the standard of lisle twist which is □ 4½ and figures 19.62. This is yarn for lisle hosiery.

Sample 5. Sample of yarn, twisted 17.75 twists per inch, illustrates the standard of mercerizing twist which is □ 4 and figures 17.44.

STANDARD OF HOSIERY TWIST.

Sample 6. Sample of yarn, twisted 15.35 twists per inch, illustrates the standard of hosiery twist which is □ 3½ and figures 15.26.

Sample 7. Sample of yarn, twisted 14.20 twists per inch, illustrates the standard of filling which is □ 3¼ and figures 14.17. This filling of standard twist is distinctly different from the above warp standard twists in that it is practically universally recognized.

Sample 8. Sample of yarn, twisted 12.98 twists per inch, illustrates the standard of underwear yarns which is □ 3 and figures 13.08.

Sample 9. Sample of yarn, twisted 8.77 twists per inch, is □ 2 and figures 8.72. Most spinners agree that this is the least number of twists that can safely be put in a single thread for any practical purpose.

In twisting ply yarn the best results are obtained when the single yarn is spun to the same square as twist required. With the exception of Sample 3 none of the illustrations conform to this requirement. No. 248.

CCXLIX. THE MODERN OVERSEER.

It is difficult for the modern overseer to understand how a twisting department with varied lines of work can be run without some such method as is here described, but the men of the old school did not have the variety of yarn in number and twist to the inch to deal with, nor did they have the exacting requirements. An approximate twist would easily pass at one time, but to-day it must be more exact. Sometimes, the twist in the single requires a specified number of twists to the inch. The yarn made for the same purpose, weaving, knitting or even lace-making, should have the twist in the single as well as in the double uniform.

Streaky dyeing is very frequently caused by yarns being mixed, which in the single received a different twist, but in the double were twisted to the same number of turns to the inch. This is a feature that is not heard much about, because if looked into too closely by the cloth makers, they would insist in having their yarns uniform, and this would entail on the spinners a great deal of bother and inconvenience.

It is the common practice that if an order calls for 2-40 C.P. warp twist, the single yarn would be taken out of a lot of yarn spun, perhaps hosiery twist. To understand this properly, let us say that if the above order for 2-40 C.P. warp twist was a repeat order, and the first order was filled with the single yarn twisted warp twist, and although receiving the same

twist in the double, can it be imagined that if mixed in the goods these two lots of yarns would color the same? By no means, for it may be said with complete assurance that the goods would color streaky.

STREAKY CHAIN WARPS.

The writer has seen streaky chain warps delivered from the dyehouse. These warps were made out of 2-40 carded yarns which were known to be uneven in twist. As the yarn was bought from an outside yarn mill on spools, the extent of the mix-up could not be obtained, nor was it possible to establish a claim, but the variation in the doubling twist was some 20 per cent and we may readily conjecture that the same carelessness in the twisting was exercised in spinning the single yarns. Unfortunately, there was a large amount of this yarn in stock.

The dyer was entitled to sympathy in his efforts to get level shades in these warps of this yarn sent from the dressing department. He was not informed of the condition of the yarn, but made many remarks which indicated that he was suspicious that the twist was irregular.

The question may be properly asked, why was the dyer not informed as to the true condition of the yarn? The explanation is of a kind too conspicuout by its presence in the mills. It is a case of shirking responsibility and of a kind that seems to a certain extent justifiable.

If the dyer knew that the yarn in the above warps had various twists a claim would have been made against the dressing room by the dyer for the extra cost entailed in the dyeing of these warps, and the claim on the dyehouse for the loss in seconds woven from these warps would have been repudiated, and all claims and extra charges would have had to be met by the cloth department and seemingly there would be no way of establishing claims on the maker of the yarn, who was the one at fault.

No. 249

CCL. WEAVE ROOM.

Good warps are absolutely necessary in the weave room if we are to have good production, and let us say right here they cannot be too good. What is meant by a good warp? By showing what bad warps are, the inference can be drawn as to what a good warp is or ought to be. In one mill where a new man had taken charge of one-half of the weaving, from the first day of his charge to many weeks afterward, it was a common sight to see warps cut out for faults in the dressing room, ends coming up broken, tie backs, soft run selvages, soft sized warps, glazed warps, the last cut on the beam run on in bad shape, and what is possibly the worst of all, rolled threads, that is, threads crossed and twisted, so that when the weaver had apparently straightened them after weaving several yards, they would come up crossed again. These were not isolated cases, but were so common that out of several hundred looms it would have been a hard task to have found one hundred warps that did not have one or several faults of greater or lesser extent.

The cutting out of these warps, which was necessary to stop the faulty work, eventually caused friction with the dressing department. Although the warps were shown to the overseer of that department, he advised cutting them out. In addition to the foregoing faults, a sizing compound was being used that did not lay the fibres, and the result from such is very well known. Of course, some low-grade cotton was being used as well. Now the superintendent of this mill was supposed to be a weaver, and one who used to spend a great part of his time in the weave room, but, as already pointed out, he could see faults where none existed, but failed to discover them where they did exist. The result was that there were many changes made in the department that was least to blame.

THE KNOTTING MACHINE.

Once in a while the knotting ma-

chine would get out of order, the result being flat places in the warp. This meant either the ends had to be crossed over from the selvage or a number of small bobbins with yarn on them used. Thirty crossed ends have been found on more than one warp, and as many as twenty bobbins used on other warps. These statements are not exaggerated, and surely the inference can be drawn as to what a good warp ought to be, and it is a pleasure to state that there are mills which take great care with the dressing of warps, realizing that even the cutting out of one warp means considerable loss in production, and even though bad warps may not be cut out, they increase production costs.

The words "cut out" are very easily spoken, but let us consider what they mean. There is the cost of drawing-in, the warp attendant's time carrying back and forth, the fixer's time putting the warp in and then taking it out when other looms may be waiting for him, the room girls' or weaver's time starting up the warp, loss of yarn and most certainly loss of production. In addition, these happenings do not tend to a better feeling in the weave room.

How careless some persons are with harnesses and reeds, yet how necessary good harnesses and reeds are to good weaving; one cracked harness eye will cause lots of trouble, and even one wire in the reed a trifle forward of the rest will make the shuttle run crooked. Fixers themselves are sometimes to blame for

BAD HARNESSES AND REEDS,

for when they take them out of the loom they throw them on the floor, or when they should put them on the hooks provided for them, just simply throw them on, instead of taking half a minute longer to place them on right. Especially should care be exercised with harnesses that are used in connection with stop motion wires, for they are so easily tangled, and in justice, we must say that some badly drawn, knotted or twisted warps coming into the weave room are really caused by the careless fixer, but as often happens, the latter does not get the bad warp.

When taking out the lease from the loom it is necessary to tie it tight and allow sufficient length of yarn at the back of the harness, especially if a knotting machine is used, because if the lease is loose, the wires get tangled in the yarn, and it takes the twister some time to straighten them out, or there are flats at the machine, or if the yarn is short in length, the operative does not have sufficient leeway.

The beam heads ought to be overhauled quite often, and lack of attention to this spoils many good warps, for when the flange works loose, the threads at the side drop down and bad selvages are the result. Strange as it may seem to many overseers, the fact is that in some mills leather is not tacked onto the cotton harness shaft around the harness eye. There being no protection for the cotton harness at this particular place, it is the most fruitful source of damage to the harness, and sometimes the weaving of one warp is sufficient to destroy a set of harness. Scrap-roller leather is generally used for this purpose, and the cost is small but the saving is great.

A warp should not be too wide on the beam for the harness, two to six inches wider than the harness being all that is necessary. If too wide, there is too much strain on the threads at the sides, and while they may weave, they are likely to give lots of trouble, and besides, there is the tendency to make ragged selvages.

No. 250.

CCLI. THE FANCY MILL.

Many dollars are lost in the fancy mill through wrong figures relating to the number of ends for each warp. These are often anywhere from ten to a hundred or more than is necessary to make the cloth. This does not refer to the using up of old warps, but to the actual making of new ones for new orders. Particularly is this so with regard to top beams, or where more

than one warp is used; it is also true of repeat warps. The extra threads do not help the weaver but rather are a detriment, as the loose ends have to be constantly wound up or they will be dragged around. It is possible for a ball of yarn to cause uneven cloth, for if the yarn has been allowed to drop on the floor for a while and then wound onto the ball, there is, naturally, added weight against the friction.

in the weave room.

Every make of loom is not adaptable to every style of fabric, in fact, every make of cotton loom cannot be adapted or changed over to make all kinds of cotton cloths profitably, yet you possibly would gain the impression that some people believe they can make a loom turn out any kind of fabric the way they manipulate or add parts to their looms. Now there are looms that can be changed over

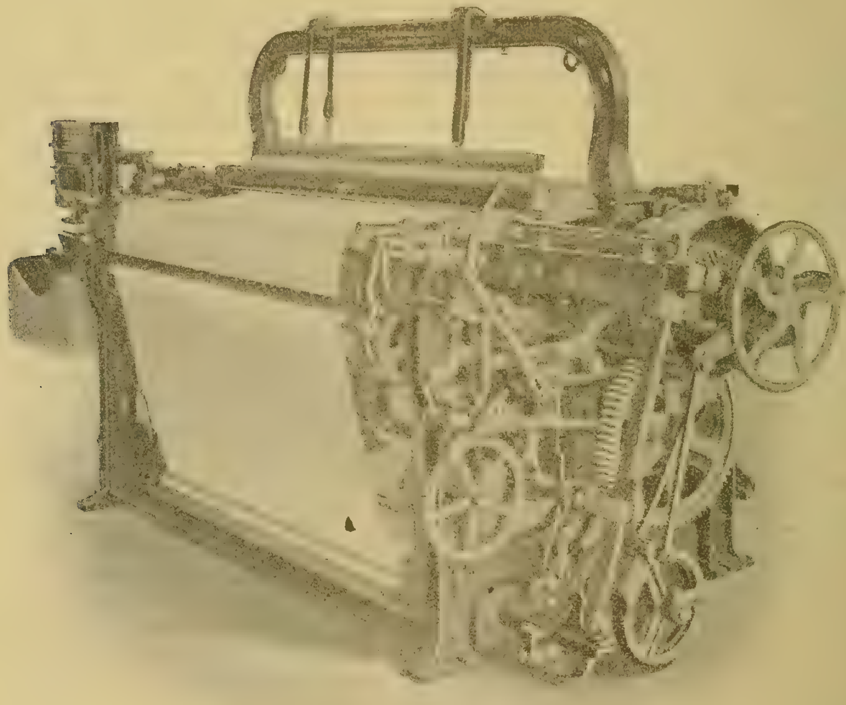


Fig. 114. Two-Harness Automatic Loom.

Careless handling of empty beams, both in the weave and dressing room, will cause much trouble for fixer and weaver, bent gudgeons causing the beam to run unevenly. Sometimes the beam head is not balanced, which will have the same effect as a bent gudgeon. One cannot be too careful in the handling of these things that are so necessary to obtain the best results

and have parts added so that the majority of fabrics can be made on them, but they are not many. It most certainly is

NOT GOOD JUDGMENT

to take old looms and add dobbies to them, say, twenty harness-dobbies, without considering first whether the loom will hold the harness or not, yet such changes are made, and even

after the crank arm has been lengthened, there is not sufficient space for the harness to move freely. The result is that stronger springs have to be used, which means added weight for the dobby to lift, and there never was a dobby fitted up under such conditions when using the full number of harnesses that gave decent results, the agent using these patched-up machines is not a practical weaver, and he wonders why his mill cannot make as good cloth and as high production as other mills.

Attempting to make cloth too wide for the harness is also another fault common with some changed-over looms, and these changes most always occur in mills that have formerly been making plains, twills and sateens, and because 40-inch cloth has been made on a cotton harness, without thought of the difference in take-up, etc., forty-inch cloth is ordered to be made on the converted loom. Some cloth 40 inches wide on the roller can be made with harness frames measuring 43 inches inside measurement, but as a great many 40-inch cloths made on dobbies spread to at least 42 inches in the reed, and often to 42¾ inches, there is not much room left, and it is a rare thing for a harness to lift absolutely straight without any swinging at all. So what must be the effect on the selvages under such conditions, and yet, some of the higher powers wonder at the variance in width and weights.

Another

VERY SERIOUS FAULT

is that it takes much longer to draw in thread at the side when the full width of harness is being used, and of course, this means loss. It is not a pleasant thing for the weaver to be constantly catching the knuckles of his hand in the top of the harness, yet this is a common occurrence with some looms when the full numbers of harnesses are used; this is caused by the dobby or hand motion being fixed too far forward so that when the lay goes back the reed cap strikes against the harness, and the fault cannot be overcome, because the last harness is against the crank shaft when it has been pushed back of the lay cap.

The faults mentioned with regard to the converted fancy loom have been seen on the converted cam loom. Trying to make a loom weave five-harness cloth when originally intended for three at the most, does not seem like sound judgment, because more space is required proportionately to run the harness by means of cams than by dobbies, first, because of the space occupied by the roll top motion, second, because of the swinging of the jack underneath, and when cotton harnesses rub together, there is trouble. The harness hook is a trifle wider than the harness shaft, and the results have already been mentioned. There have been attempts made to weave five-harness cloth and the reed cap has struck the harness at every backward movement, and the harness jack has actually stuck and sometimes caught on the brace in the loom.

The instructions given when we first set up dobbies or any other motion are, throw the lay to the back centre, drop a line to the first harness, set motion so the line will be a half inch back from the reed cap for these two reasons: the weaver has room to put the fingers on lay cap, and the less the harnesses move, the less friction on the yarn.

TOO MANY HARNESSES.

It is not always an advantage to use a large number of harnesses when a smaller number can be used, say, multiplying on four, six, eight or ten harnesses, with the thought in mind of less crowding of the heddles. Eight or even twelve are not too many in a general sense, but when sixteen, eighteen or twenty are used, it takes much longer to draw in the yarn, and the reaching over is not easy for the woman weavers. There is also another great fault incident to a large number of harnesses, that is, the farther off the harness is from the fell of the cloth, the higher the harness must rise to give proportionate shed; this increased lift adds strain and chafes

the yarn, but there is also another evil that must be avoided if possible, that is, crowding the heddles; the eight to twenty-four on an old-fashioned head motion, and since the time that head motion was made, the harness shafts had been increased in thickness, with the result that twenty-four harnesses occupied at least one and one-half inches more space than the harness straps; and a further

Fig. 115. Weave Shed of a Southern Mill.

probabilities are that the lesser evil is increasing the harness to avoid crowding.

We have in mind a case where the harness was increased from

result was that the harness straps were constantly riding, and the pressing of the lay against the harnesses prevented them working freely up and down, so that the yarn was in the path of the shuttle, and the final result is very apparent—a flying shuttle is dangerous to the operative. There is an advantage in increasing the amount of harnesses to a certain number, to decrease the crowding of the heddles, yet not to the point of increasing the work of the weaver or crowding the harness space.

Drafting down a pattern is all right when a large number of harnesses are involved, but when only ten or twelve are required without reduced drafting, it is not advisable to reduce the draft, because this fact must be considered: the more the harnesses are reduced in drafting the more complicated is the drawing-in of the draft, both for drawing-in hand and weaver, and this occasions loss of time. No. 251.

CCLII. MAKE-UP OF A LOOM.

To the casual observer, there is no material difference in the make up of a loom (we speak more particularly about the new loom), yet there is a vast difference not only in the quality of the workmanship, but also in the weights of cloth a loom will weave. Some are made for high speed and light-weight cloths, others are made for medium weights, and yet others are made for heavy-weight cloths, but there are one or two makes of looms that will weave a wide range of cloth and give good satisfaction. Fine lawns have been made on a certain loom, which was then changed to nine and a half ounce goods, and possibly a heavier cloth could have been made. On another style of loom of the same make, the writer has woven three-ounce cloth, then changed over to 12-ounce goods, and there has been very little trouble with the loom. Now take other makes of looms on which prints have been woven: We have been ordered to make drills weighing six and seven ounces, and after weaving a few yards, the loom has been almost in pieces. The result was, the order had to be cancelled so far as the mill was concerned. The trouble was in trying to make cloths the loom was never intended to produce, and it took a long time to convince those who ought to have known better.

If this fact was kept in mind, it would save much friction between overseer and superintendent and also save loss of time. It requires weight with power to make a solid cloth. For example, take a medium weight loom of a good make, and add an iron brace under the lay, also increase the eccentricity by raising the lay or extending the lay, and a cloth of several times the original weight can be made on that loom.

Some looms are made for high speed and they run better if the loom is kept up to high pressure; it is much easier for the fixer and this, of course, means higher production. Looms are also made to run about 160 picks per minute, and it is unreasonable to run these looms at 180 picks and expect good results. High speed is not always consistent with the best of production, and for one, the writer is glad to see there is a reaction in favor of slower speed, that is, speed consistent with the build of the loom. No. 252.

CCLIII. CONCERNING THE LOOMS.

Referring back to the re-arranging of the loom to make cloth it was not intended to make at first, the following will possibly be found of value: With the majority of looms, when the lay is on the front centre, the lay sword is perpendicular. It will be noticed with such looms that when the lay is moved to the back centre the yarn rests heavily on the front edge of the race plate, but is off the plate at the back edge to a greater or less degree. When fine yarns are being woven, the fault mentioned chafes the yarn, and if the latter does not break, a rough cloth is the result; also, the shuttle cannot run true under such conditions, and the faults

from a crooked running shuttle are well understood by all connected with the weave room. To remedy this fault, a strip of packing, wood, leather, or paste-board, one-eighth to one-quarter of an inch thick can be placed between the lay and the back of the lay sole. After the packing has been inserted, the protection motion must be examined, because the protection rod has been thrown forward to the extent of the thickness of the packing, and one of two things will have to be done, either shorten the dagger or fix the binder to raise the protection rod sooner. This change will be found beneficial in the weaving of a great variety of cloths.

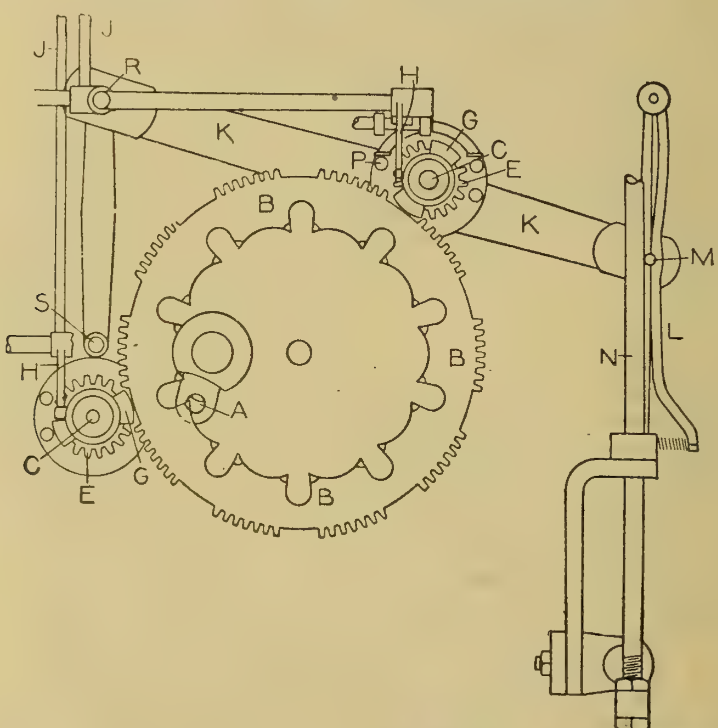


Fig. 116. Lower Box Motion Known as Pin Gear Motion.

TWO OTHER VALUES

are obtained from this fixing: First, it lengthens the distance between crank shaft and back of lay, giving more space for the harness, yet does not decrease the eccentricity of the lay, but actually increases it, and, of course, this gives a greater value to goods generally woven on such looms. Second, there are some looms made, and generally with back binders, that have a bad tendency to pinch the shuttle if the loom happens to vary off with the shuttle in the shed, making a thin place, and often breaking the yarn, and if the brake is set to overcome this fault, the loom locks when it bangs off. A word regarding the eccentricity of the lay may be of value to some one having such looms, or desiring to overcome other faults: Without raising or lowering the lay the eccentricity can be increased, or decreased by lengthening the lay and decreasing or lengthening the crank arm.

In some mills there is found a

LACK OF INTEREST

in the fine points of producing cloth;

that is, a warp is put in and so long as it starts up all right, and the cloth appears to be pretty fair, it is allowed to pass. The fact as to whether the best is being obtained or not is no concern of the fixer's, and sometimes those higher up. We refer especially to what is termed cover—a polish or finish to one side of the cloth; yet the value of the cloth is materially advanced if such is obtained, and it costs no more when done right. The same setting of the harness will also remedy reed marks. The following is a particular instance: An agent said to a new overseer, "Have you seen those cloths?" pointing to certain looms. "Not yet." "Well, let us have a look at them." To say the cloth was hardly fit to be seen was giving it all it deserved. It was bare looking, had reed marks and was decidedly poor. The cloth was intended for light-weight flannel, but, of course, it had been objected to. Now the superintendent of this mill knew all there was to be known about weaving, at least he said so; but he did not know what to do in this case. The fixer stated he had tried to remedy the fault, but instead of obtaining what was wanted, the warps were made to weave poorer, and the shuttle kept flying over or out, and he told the overseer it was useless to do any more. "All right," said the overseer, "let us see. Raise up the whip roll arm a trifle and bring in the roll to the next notch. There will be

LESS ACTUAL MOTION,

but we will get what we are trying for—a top shed looser than the bottom, yet not too loose to cause the shuttle to skip; set the shed level with crank shaft just forward of bottom centre, so that the shed will be fully open or nearly so when the reed comes in contact with the cloth, then try the loom; raise the false breast beam a trifle, set the lease rods in a little, then adjust the weight and the result will be just what was wanted." The setting of the harness on a lower level than a line drawn from breast beam to whip roll with other parts adjusted to their right relation is all that is needed, and the difference in the cloth is surprising when this rule is followed, no matter what kind of fibre is being woven. If a cloth is being woven with the largest number of harness raised, the whip roll often has to be set in the opposite relation, that is down below the level of the harness.

REGARDING THE WEAVING

of a warp satin or a warp twill and other cloths of like description the right side up, it is often possible to weave such cloths filling side up and obtain just as good a warp effect. Many object to this, but the writer has made warp-cloth filling side up. An imported three and four harness twill had to be duplicated, and we did not have cams to make the cloth warp side up, so made them filling side, and by adjusting the harness and whip roll a cloth was produced equal to the sample and was accepted. The lighter the lift, the less strain there is on the harness motion, the less power required to drive the loom, and naturally increased production and less cost in supplies. Where it is at all possible to weave cloth with the lightest lift of harness it ought to be done. Bobbins play an important part in the production of cloth, yet it is surprising what the overseer of weaving has to contend with sometimes: Filling run down into the ring on the Draper bobbin; too much yarn on for the size of the shuttle; bad threading up when starting the spinning frame; uneven open bobbins, and possibly the worst of all, if such a thing is possible, different lengths of bobbins. Now, strange as it may appear to some overseers, such things do exist, and there are cases where the overseer was held responsible for bad cloth resulting from bobbins such as described. We are not referring to a few bad bobbins, but thousands of them, say, one to three large cabs full every day. When the rings are covered with filling it is a risky thing to put them in the

hopper, for there is always the possibility of a smash, which is costly both in

PRODUCTION AND QUALITY

of cloth, and bobbins just the least bit too large with the filling on them so that the weaver does not notice them, invariably cause a smash. Bad threading up is the cause of more poor cloth than possibly any other fault, and if this is not the trouble, it requires considerably more work on the part of the weaver or battery filler, for the filling is constantly breaking, and this means one bobbin to be placed in the battery several times before all the filling is wound off. Bobbins too short are a costly nuisance, and some superintendents, wise enough to see it, realize that every defective bobbin is liable to cause a smash that will have lost more and cost more than a number of new bobbins. It is conceded to be good judgment, and this means in the last analysis good management, when the overseer or superintendent realizes the limit of usefulness of supplies or parts of machinery, yet there are mills using bobbins that cause losses by the dollar, and many overseers have lost their positions through the person higher up not realizing that certain supplies have become useless and not the overseer's ability. As a great deal, everything, in fact, depends upon the condition of the bobbin that enters the shuttle, so the aim ought to be to give the weaver the very best bobbin possible both as to build of yarn and physical condition; but there are some people who act as if the opposite were better. You who are allowing such stuff to go in the weave room, just get down to business, give your weaver a chance to see how much he can increase your production. No. 253.

CCLIV. BATTERY FILLERS.

It is a much mooted question as to whether it is better to have battery fillers or the weavers fill their own and the locality is often the solving of the problem. If young help is to be obtained, battery fillers are beneficial, because the weaver's whole attention can be placed on the loom with a consequent increase of production, and in addition, weavers are being trained, for if the battery fillers are not too hard pressed they will very soon have learned to weave. This allows a supply of home talent who know the workings of the mill.

The matter of supplies is one that requires careful consideration, and it is much better to follow a system in dispensing with the major part of the supplies; we do not say all, for reasons that will be considered later. In some mills picking sticks, shuttles, pickers and all general supplies are given out at certain times, the supplies checked up and amounts placed on a specially printed sheet, the same sheet being exposed in a convenient place, and if a fixer exceeds a certain quantity a red mark is put against his name, and he is also told about the excess. A good fixer takes pride in the low cost of supplies, but the indifferent man requires jacking up and this exposed sheet method is a good way of jacking him. Other mills check the supplies, but do not expose the amounts each fixer receives, which tends to indifference. There are few mills to-day that do not check up supplies direct to the fixer, and if there were none at all it would be better. Now there is a difference between checking supplies and checking everything a fixer needs. For instance, there are places where the fixer requires a note to get even a bolt that may be worth five cents, and a great deal of time has been lost finding the second hand, store clerk, etc. In other places every casting required has to be obtained through the clerk, and you may judge what that means. Now it is possible to keep track of the wasteful fixer in a better manner than tying up everybody else, and it always has been found to pay best to trust a little. The no-account fixer is found out in other ways beside the waste of castings, for his other supplies pretty soon tell the story; so we believe it best that

castings and bolts be free for the taking.

THERE ARE TWO WAYS

of charging the machine shop cost against the weave room: First, by having men set apart to do that work and their wages charged; second by checking the time for each job. The first is by far the better, as will be seen by the following: A fixer had a pulley not working right. The person assigned to the weave room jobs spent a whole day on and off dickering with that pulley; the machine shop was five minutes walk from the loom, and the number of times the machinist travelled back and forth would have required considerable marking up to keep an accurate number. Eventually, the overseer saw there was omething wrong, made inquiries and found that the repairer was not trying to fix the pulley; several bushings had been spoiled, and this was charged to the weaving department. The incident noted caused the overseer to inquire a little closer and also watch out for such dealings. Now, a fixer took out a take-up roller to have the perforated tin fixed up and the roller turned up; a short time after, he went for the roller, could not find it nor the man supposed to do the work. He went several times, and the same thing occurred each time; eventually the case was reported to the overseer, as notice had been given to that effect, and on inquiry, it was found the roller had been locked up, as the repairer said, so that he could find out who the fixer was. Happily, such cases

ARE NOT COMMON

but we believe it a much better system to assign a man who feels he is hired to do some work for his pay, and believes the quicker and better he can do a job, the better satisfaction it gives, and his pay and the cost of material charged to the weave room. Naturally, the overseer takes an interest in whatever is charged against him, because it is a question of how much it costs him to produce, and whether everything, castings or anything else, should be charged direct to cost per pound in the weave room is a question for each mill to decide for itself, but it does not seem right to charge new beam stands against the weaver, for those ought to be added to equipment, yet there was a case where a mill took orders for several beam works, and the castings for the additional beams were chaiged against the weaver and figured in his cost of production. Not only were the stands charged as stated, but the cost was

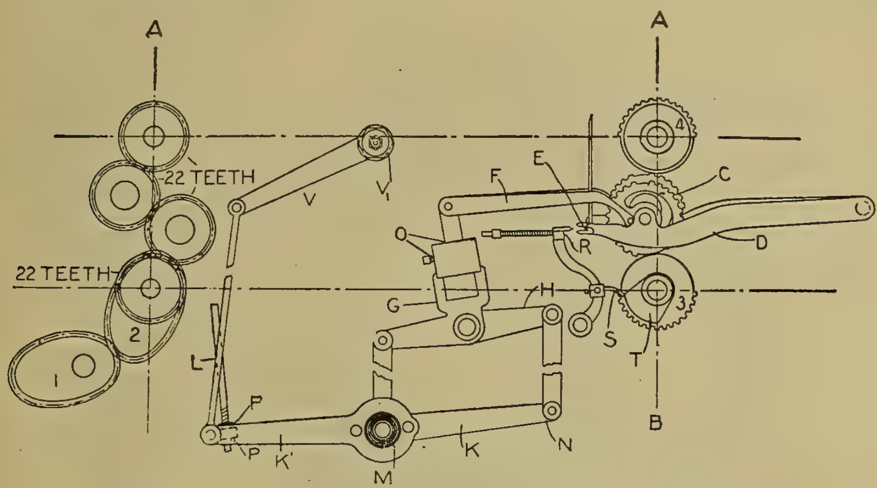


Fig. 117. Diagram of Gearing, Box Loom Motion.

distributed over the whole production, which gave a false cost to the entire product, for added cost was assigned to styles that did not require the additional parts. Some readers may think the above a trifle overdrawn in an article on good management, but the writer wishes to assure you that it is one of the factors that enters in the making or marring of an overseer or superintendent's record, for there is no man of any account but watches very closely his cost sheet, and a good manager is very jealous of what is charged up against him; and there is

A TREMENDOUS SATISFACTION

in feeling that his cost of production is at least lower than his predecessors. Where is the man who does not feel better when he knows the main office is charging him for what are actually supplies or legitimate costs? He then knows it is up to him to make good or make room for someone else. Some of the higher officials have an idea that it spurs on the overseer to do better if they charge everything against him, but this is not so, for a self-respecting man desires to see his cost as low as it is possible to bring it down, of course, consistent with the good running of his room. This brings out another feature that can well be considered under good management namely: Is the overseer allowed freedom in the running of his room, or is he held in very restricted bounds? Some mills allow their overseers to hire the help that they feel is necessary for the upkeep of the room both as to cleanliness and good production, and no restriction is placed on the amount to be spent for odd help, that is, other than piece workers, and in these mills they demand high production, and generally they get it. Other mills, or rather a few superintendents allow the overseer so much to run his room, and he must not exceed this amount no matter what the circumstances are. Now the latter method may be good in some cases, and with some men, but when the amount does not allow for changing over, and covers only the help required to run the room based on the very best conditions conceivable, it most certainly

IS NOT GOOD MANAGEMENT

and it cannot be said that trust is being placed in the overseer. An instance will best illustrate this fact: In a certain mill the overseer was allowed an amount sufficient to hire help to fill positions absolutely necessary when everything was going well and help plentiful. There came a time when considerable changing of take-up gears had to be done, and, of course, this takes time, especially if the gear has to be changed on the first cut mark; then it came a question of changing cams and the roll top motion, but still no extra help was allowed, nor even extra pay to the fixer, and there was no spare fixer. A little later on through some fault or other the yarn commenced to chafe in the drop-wires and bunches formed on the yarn. This, of course, meant loss of production, but the overseer had to balance his production against his cost. He pleaded for a spare fixer, and a little leeway with a spare weaver to help the weavers to get out some one else's bad work, and showed where it was possible not only to increase the production but make better work and naturally lessen the cost, but no, "he must keep within the allowance." Eventually, the overseer did what he believed was right, he also wanting to prove his contention. He hired a helper for the fixers; of course, he exceeded his allowance and there was a row, but he reduced the cost of production three mills per pound that month, yet with this proof the higher power demanded that the room be run inside the allowance. The trouble was the allowance was not enough to meet changing conditions. This is an absolute truism well known to all good managers, that high initial cost is not incompatible with good returns, and low ultimate cost of production. No. 254.

CCLV. THE DOBBY HEAD MOTION.

The dobby head motion is the part

of the loom that raises or lowers the harnesses according to the pattern desired. When speaking of a dobby, it is customary to say it is a 12 or 16 harness dobby, which denotes its capacity.

There are various makes of dobbies in use, all of which can be classed under two heads, "single" and "double" action dobbies. The double action dobby can be further classed as "single" and "double" index. The meaning of the terms single and double index refer to the index fingers. In a single index machine, there is only one index finger to each harness, or for the two jack hooks, and there is only one row of pegs in each bar of the chain, one bar representing one pick. The double index machine has two index fingers,

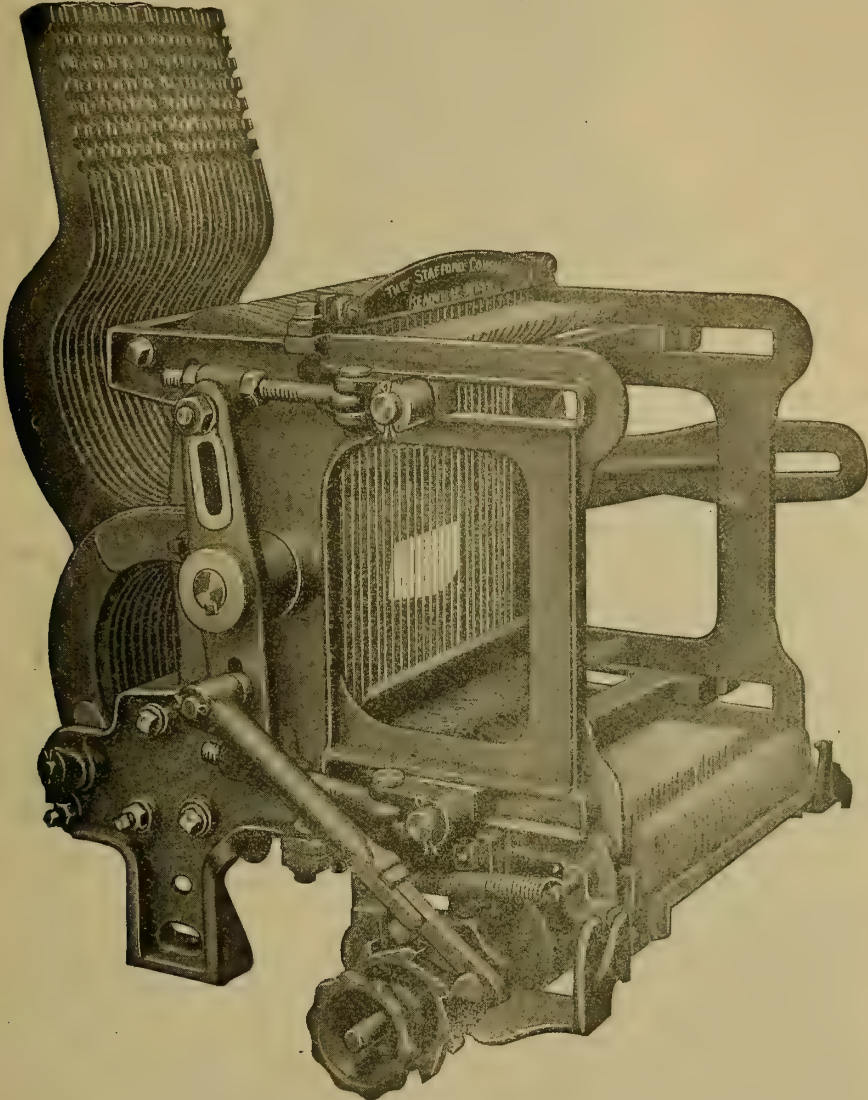


Fig. 118. Twenty-five Harness Double Index Dobby.

one for the bottom hook and one for the top jack hook and has two rows of pegs in each bar of the chain, one bar equalling two picks.

SINGLE ACTION DOBBY.

Single action dobbies are used in the manufacture of fancy gauze patterns. One disadvantage to this dobby is that the loom has to be run at a low rate of speed on account of the harnesses having to be raised and lowered at every pick. Another disadvantage is that the filling has to be beaten up into the cloth while the shed is closed, thus it gets its name—a "closed shed dobby." The double action dobby is the most adaptable for all kinds of work. By using a "yoke" and a "jumper" motion a large number of leno patterns can be run on this dobby as well as on the single action dobby.

The working parts of the single and double index dobbies are practically the same, the only difference being in the way the jack hooks are worked from the index fingers. On the single index finger, there is a groove or slot into which a needle rests, the upper portion of the needle supporting the top jack hooks. On some of the older style dobbies, instead of this needle being at the curved end of the finger, there is a wire connecting the bottom index finger to another set of index fingers supporting the top jack hooks. When the bottom index finger is raised, the top one is raised as well, which performs the same work as the needle supporting the top hook.

The dobby can either be driven from the pick cam shaft or from the crank shaft. When driven from the crank shaft, one method of driving is as follows: A gear on the end of the crank shaft sometimes a 30 gear, meshes with a gear with double this number of teeth in it. This gear is on a small shaft that has a bevel gear on the opposite end. This bevel gear meshes with another bevel gear of the same number of teeth, fastened to an upright shaft. There is a worm attached to the upper end of the shaft working into the worm gear fastened on the end of the chain barrel shaft.

On a number of dobbies instead of being driven through the two small shafts, there is a small horizontal shaft attached to the side of the dobby just below the worm gear of the chain barrel. On one end of this small shaft is a worm working into the worm gear. On the opposite end is a sprocket with a chain connecting from this sprocket to a sprocket on the same shaft to which the 60 gear is fastened. This motion is not so easy and smooth as the previous one. When the dobby is driven from the pick cam shaft, the driving rod is connected from the rocker shaft arm to a crank fastened to the pick cam shaft. A pawl is sometimes used to turn the chain barrel when using this drive. This pawl is attached to the front rocker arm and rests on a ratchet on the chain barrel shaft

SETTING A DOBBY.

In setting up a dobby, care should be taken to see that the dobby is set on the stands as level as possible. The card rollers or sheaves, as they are sometimes called, are in a position so that the harness shafts will be suspended an even distance from each side of the loom; also, have the first sheave adjusted, so that the front harness will be about one-half an inch from the lay cap when crank is on back centre. The spring blocks can be set in position on the floor by dropping a line from the sheaves at the side on which the harness straps work. This will be the centre of the spring block.

When starting up a new dobby, care should be taken to see that all the parts work free and that the harness levers are adjusted so that they will not bind, but will drop down on their own weight. When setting a double index dobby, see that the worm is set on the right pick, that is, so that the dobby is set so that the top knife coming out will take the first pick. The first row of pegs in the chain is usually for the top hooks.

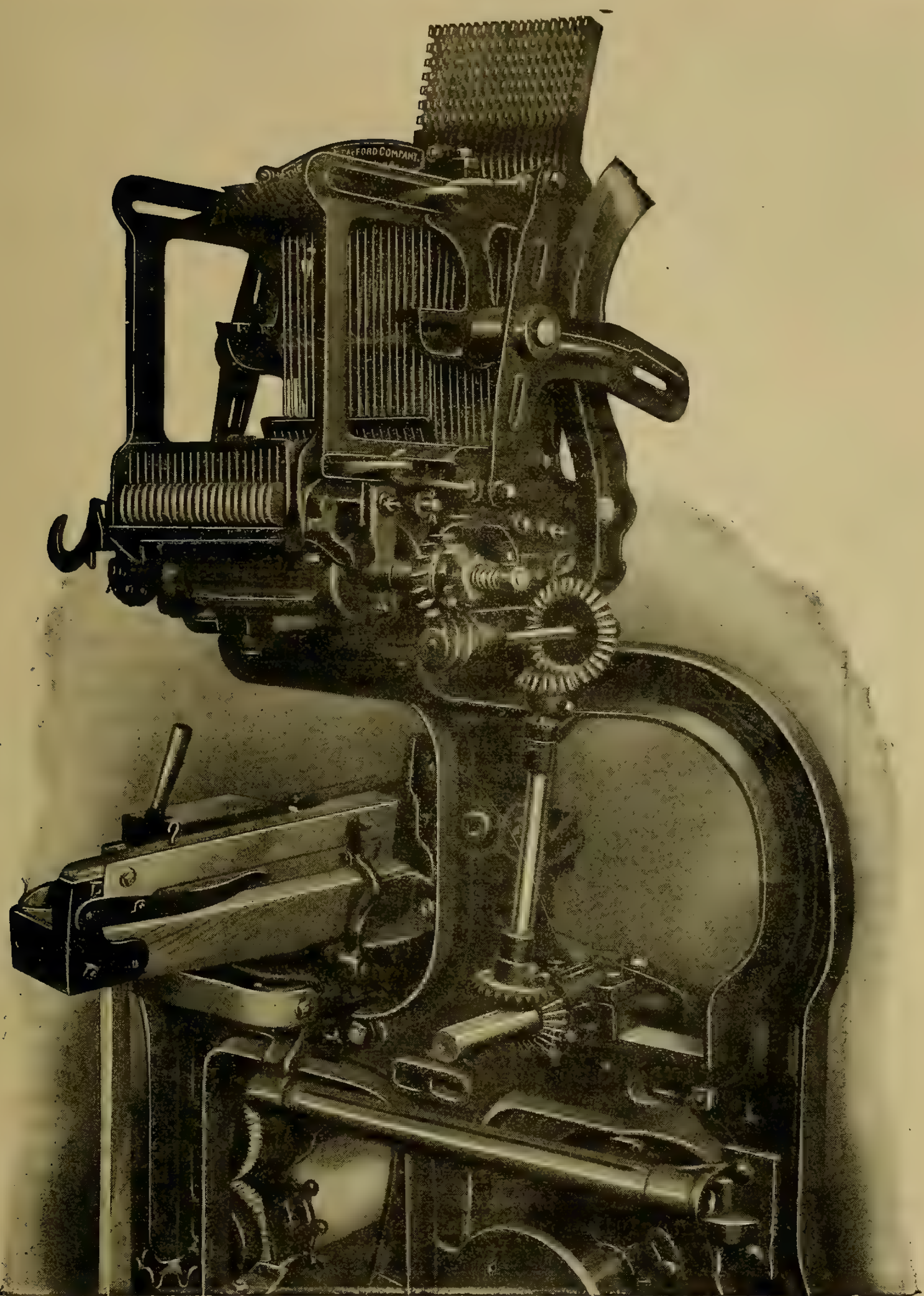


Fig. 119. Twenty Harness Single Index Dobby Mounted on Loom Frame.

Should the dobby be set so that the bottom knife takes the first pick, then a broken pattern will result. The reason for this is that the second row of pegs in the chain comes under the index fingers that the bottom row of jack hooks rests upon, causing the harnesses that ought to be lifted on the second pick, to be lifted on the first; or, the picks are put in as follows: The second picks will be inserted as the first, and the fourth as the third, and so on.

The

SIZE OF SHED

required on a dobby is just sufficient to allow the shuttle to pass through without chafing the yarn. There are a number of ways in which the shed can be regulated: First, by grading the harness wires in the notches of the harness levers; secondly, by changing the position of the driving rod in the slot in the gear; thirdly, by changing the position of the swivel in the slot in the rocker shaft arm, and fourthly, by having the knives either closer or farther away from the hooks. The grading of the harnesses wires is claimed to be one of the best methods. By this method an angular shed is obtained, that is, the back harnesses descend correspondingly lower as well as rising higher. This allows the yarn in the back harnesses to be close to the race board and helps to make a clearer shed. Usually the back rocker arm is longer than the front one, and this will increase the size of the shed. There is danger, however, of having the end of the knife working out too far in comparison with the front end. This will cause the knife and the hooks to wear also, and will bend the needles, thus causing mispicks. Considerable cloth is often spoiled on account of the condition of the dobby. For instance, in a number of machines the top and bottom jack hooks are of a different length and shape; still oftentimes a fixer will try and use one for the other, and continual mispicks is the result.

When replacing a broken grate, the new grate may be rough and if it is put in that way, will cause the hooks to bind, or not allow them to rise out of the way of the knife when the harness should be down, and the result is a mispick. Bent jack hooks are another source of trouble. Among other things that will cause mispicks are the following: A worn stud on the harness lever will allow the jack to slip off instead of raising the lever; harness levers being bound by the set screws being too tight against the plates against the harness levers; short or broken pegs; barrel not being set true, either too far forward or too far back, too high or too low, or not being set level, one side higher than the other; worn knife; worn hooks; rough index fingers; the side of the groove on the under part of the index finger being worn away by the pegs, allows the peg to slip in between the fingers instead of raising the index finger; a weak spring on the chain barrel will allow the barrel to turn too far around; a worn lever bolt, which passes through the slot of the harness lever, allows the lever to come out from under a bar it is supposed to be always in contact with; the end of the lever pulling away from this bar will make a difference in the lift of the harness, it not being raised so high, thus threads are often broken out, causing rough cloth and thin places; oil and lint collecting in the index fingers will cause mispicks; the bars of the chain being too large for the barrel, when passing over the top they are forced into space and instead of dropping out from the barrel, are taken around, causing the chain to wind up; a worn knife slide or too much play in the slide allows the front edge of the knife to tilt up and will often throw off the hooks, or will be tilted high enough to catch the other hooks when the harnesses should be down; again the hooks may not be completely on the knife and will drop off, making mispicks and thin places and cause the shuttle to fly out. Unequal

springs also will produce what would be called mispicks.

SETTING THE HARNESS.

Another important thing is to see that the harnesses are not set too near the lay cap. The front harness ought to be set about half an inch from the lay cap with the crank shaft on back centre. Should the chain barrel be set too high, the index fingers will jump, and this will have a tendency to make the hooks catch on the knives when they ought not to. When the barrel is set too low, the hooks will not be lowered far enough to set well on the knives and will slip off or they will be missed altogether by the knives. This will also happen if the hook is not bent sufficiently or the hook or knife is worn. The chain barrel must be set on correct time, but there is no absolute time that can be given. A good setting and one that will answer for a majority of cases is to have pegs directly under the index fingers with the knife about a quarter of an inch from the catch of the hooks, when on the outward movement. The setting of the harnesses is often responsible for thin places in the cloth. By one of the harnesses not being lifted so high as the rest and the reed beating up the filling, the slack yarn doubles between the last pick and the one that is being beaten up, and the filling cannot be beaten into place.

It can readily be seen from the description of the dobby head how many things there are to cause bad work—each one of which is liable to make the piece into a second.

No.255.

CCLVI. AVOIDING WEAVE ROOM WASTE.

There are probably few rooms in a mill where more power can be wasted in the running of machinery than in the weave room. One may go through this department and an experienced ear can detect the heavy running of a loom, gears grinding, shuttles striking in the boxes too hard or rattling, one side of the loom having considerable more picker power than the other. A glance at the loom would probably show that on one side, if a cone pick motion is used, where ordinarily the lug strap dog would be about one-quarter of an inch from the bottom of the pick shaft arms, with the lug strap level on the picking stick, the lug strap is probably about one inch below level on the picking stick. Taking a look at the opposite shuttle box would disclose the fact that the shuttle can scarcely be forced in the box on account of the binder being set too far in.

PRODUCTION SUFFERS.

Not only is it costing more to run the loom, but the production suffers as well, the loom being stopped frequently for repairs, the shuttle being damaged and probably chipped, in which case it will take out the yarn as it passes through the shed across the race board. Another cause of shuttle chipping is due to the striking of the shuttle against the mouthpiece as it enters the box. This may be due to one or more harnesses not being set even with the others, being higher from the race board, and causing the shuttle to rise upward. Sometimes the shuttles are split sufficiently to take the yarn completely across the warp, in which case the warp has to be lifted out and sent to the drawing room to be re-drawn.

Flying shuttles are a bad defect to contend with in the mill. Sometimes this is not the fault of the loom and other times it is. Soft yarns will cause the shuttle to fly on account of chafing behind the reed. A picker too low on the picking stick will cause the shuttle to fly out. When the picker is too low, the outer end of the shuttle will be tilted up when delivered from the box. It is advisable to have the hole of the picker just a trifle higher than the tip of the shuttle when the latter is in the box.

An expensive item in the mill is the cost of reeds. Only recently the writer had occasion to investigate a report that the

reed was cutting the yarn. Upon examination, a decided ridge was noticed across the reed where the shuttle had traveled back and forth. It was so deep there was no wonder that the yarn was being cut. Another loom showed the shuttles to be ribbed on the back through the reed, being what is known as "underjacked." Temple marks in the reeds are often responsible for a good many of them being thrown away or sent to the repairer to be fixed over. These marks are caused by having the temples set too near the fell of the cloth

Often the space between the tip of the temple and the end is greater than the width of the lay sole, so if there is nothing put on it to make up the difference the temple will

STRIKE THE REED

every time it beats up the filling. It is customary to tack on a pick of leather to the lay so as to give the temple a little start. A rebounding shuttle on a loom will increase the cost of a room, not only in the way of supplies, by the amount of unnecessary waste made by the cops breaking in two on the spindle of the shuttle, or if using bobbin filling, by having it shell off the bobbin. The loom will "bang off" often breaking the various parts which naturally means a loss of production.

The causes of a rebounding shuttle are that the pick on one side is too strong, or the binder has become loose, so that the shuttle goes into the box with such a force that the picker stick is pushed against the back end of the shuttle box and the rebound sends the shuttle toward the mouth of the box, and the next pick is a weak one on account of lost motion. The slipping of the binder finger on the protection rod is also responsible for shuttle rebounding.

UNEVEN CLOTH

is another evil one has to contend with in a mill, and it is a hard one to handle, especially where the humidity is not very even. This is particularly true where friction ropes are used. The latter will often bind in damp weather, becoming sticky, and the yarn will not be delivered from the beam evenly. In trying to overcome this it is often made worse by the dropping of oil or putting tallow on the ropes, as this collects the lint. The best remedy is to take off the ropes and clean them, then sprinkle them with powdered black lead, and sometimes soapstone or French chalk is used.

Among other things that will cause uneven cloth are the following: When using the gear let-off motion, the spring behind the pawl becomes weak and does not hold it in contact with the teeth, causing it to slip over some. The breaking of this spring will often cause a smash, the take-up gears being set in too deep. A weaver will sometimes make thick and thin places in the cloth by holding on to the finger which is connected to the rod to which the take-up check pawl is attached. Instead of letting back a few teeth on the take-up gear after the filling has run out, he will start up the loom, thus holding the check pawl from engaging with the take-up motion. Thus, the loom will be putting in the picks without the cloth being taken down correspondingly.

SHUTTLE MARKS

in the cloth are a defect to be guarded against, because if the cloth is to have a white finish they will show in the finished goods. These are caused by the filling being caught between the shuttle and the binder. A cloth with a poor selvage is to be avoided if possible. A cloth with a good selvage can often be passed for a first quality even though there are imperfections in the body of the cloth, but take a cloth with a poor selvage and the chances are that it will be thrown out for a "second" every time. Among a number of things that will cause bad selvages are the following: Not enough friction in the shuttles, allowing the filling to curl on the selvages, harnesses too low on one side, filling catching on the fork, too small a shed, too large a shed, and the way the warps are run on the slasher. If the press roll does not extend all the way across the warp, the portion that

the press roll does not touch is much larger in diameter, and when the yarn is drawn off the beams these threads slacken. Another source of expense is the changing of the bobbins in an automatic loom before the filling is sufficiently run out, often leaving as much as 20 to 60 yards of filling, and sometimes more. This is all waste, needless waste, and means added cost. No. 256.

CCLVII. WEAVE ROOM MANAGEMENT.

As production plays a very important part—in fact, the most important part—in the weave room, so will any machine or part of machine have an influence, to a greater or less degree, on that production; such being the case, the box motion and shuttle boxes ought to be thoroughly understood by those in authority; not only understood, but attention given to the upkeep of the motions; for great cost in supplies can occur through lack of attention. It most certainly is not good management for several times more shuttles to be used than what is necessary with careful attention; no more than it is good management to purchase box motions without due consideration of the fabric that has to be produced, and the speed of the loom.

There are

ONLY TWO OR THREE

real good box motions on the market, and not wishing to mention specially the makes, let us consider the essentials of a good box motion, incidentally illustrating by a little experience a very poor motion. A certain person was demonstrating a motion, and evidently thought he was one who knew all about it. After describing the parts very minutely he was asked, "At what speed can you run the loom with safety?" "Oh, up to 180 picks per minute." "That is, at 180 picks per minute you will guarantee the boxes to change from and to any position, the shuttle being thrown true, and no fear of the shuttle being thrown out?" "Oh, no, the motion will give entire satisfaction." "Well, how about fixing the motion if it gets out of order? Can an ordinary fixer repair it in reasonable time?" "Yes, and besides, the motion is made to stand up, not to be out of order."

So much for the statement of the first interested party. What was

ACTUALLY THE CASE

was this: The boxes were not set up in the same arc of movement as the lay, consequently, the boxes were level with the race plate only at one particular point in the movement of the lay, and if the boxes were set level with the crank on top centre, they were not perfectly level when the shuttle was going in the box; this meant more or less chipping of the shuttle, and it took some time to locate this fault. Part of the motion was made up of a series of levers, one of them being a swinging lever imparting motion to the main box lever, which acted as compound and single at some part of its movements. It was started up at 160 picks in the mill and for a time ran all right; but it soon commenced to show itself; broken shuttles, great amount of time required to re-set the motion, constant replacing of parts, in fact, it was a costly motion. It was made to stand up, but only when it was stopped. Such motions as these consume a lot of the fixer's time that might be spent more profitably, the production is not what it ought to be, and there is also a big waste in supplies.

REGARDING THE MOTION.

A motion that will run steadily, that can be fixed readily when necessary, and that has few parts about it, is the motion worth installing, but the best motion is of no avail if not kept up. There are two things that can occur which probably do more harm than anything else to the box motion. One is that the boxes do not work freely in the slides, either through want of a little oil, or the slides not being straight. The other is, the hole in the picker is too large, so that the shuttle is held tight when the boxes are to pass up or down, or the picker

may be too far back so that the shuttle is caught between the guide plates. These faults cause undue strain on the box motion, and sometimes picking sticks are broken. These defects can be readily detected by anyone passing through the room, because the boxes have a jumping motion. It pays to watch for these little things, for many breaks can be prevented.

Too often losses occur through not examining a new set of boxes before they are placed in the loom, for rough and sharp edges will be found on the inside; these

NOT ONLY DESTROY

shuttles, but cause false binding of the shuttle, and not cleaning off all the grease will also cause a lot of trouble.

This shows the value of having a man in the machine shop devoting his time to loom repairs, for he can thoroughly overhaul the boxes, saving valuable time and the possible loss of supplies. Allowing the picking stick bunter to wear down too low is a bad fault, for picking sticks are unduly worn, and pickers are simply wasted. Not only that, but a worn bunter causes the stick and picker to be worn in such a manner that they are the cause of shuttles flying, and more than one lawsuit has been the result of these faults.

While we do not favor the overseer fixing looms, unless, of course, it is a small mill and part of his work, yet we do most certainly believe it part of his duty to see that the machinery in his care is kept up to the best state of efficiency. He can do this without crossing the temper of the fixers, if they are reasonable men; in fact, he must, at all hazards, if he would earn his pay. Delegating such duties to the second hand is all very well in general, but usually the second hand has all he can attend to and sometimes more than he ought to have. The

FOLLOWING INCIDENT

will illustrate this: In a certain mill where Draper and box looms are run, and the help is a changing quantity, they have a fairly high cost of production, and a high supply cost. Of course, these two go hand in hand, the latter having a very marked influence on the former; and the question has been asked time and again, Why can't we reduce our supply cost? Let us see. There is strong competition in that town on the help question, but in this particular mill they pay the lowest wages for odd help that is possibly paid in any mill for miles around. Odd help that is any good at all naturally is scarce in that mill, with what result? It is a common sight to see the overseer, but particularly the second hand, wheeling filling around, picking up bobbins, straightening out mixed filling, and other such jobs that are incident to such business. We do not speak of an odd time or so, but it is a constant practice.

A well-regulated mill that has a true conception of the economy of labor does not expect, and will not allow those in charge to do the menial labor of the department, for they know full well it is impossible to get high-class production under such conditions. Not considering all the little details that enter into and cause these bad results, this fact stands out very prominently, and is a problem that some of our managers need to realize, namely, when the persons in charge do menial work they lose prestige, there is a lack of respect for authority on the part of the work people and there is constant friction.

How is it possible to prevent the small leaks that eventually become open faucets under the conditions mentioned? A number of persons

HAVE BEEN INJURED

by flying shuttles, and in almost every case the shuttle came from a box loom, and on examining the boxes the front edge was found to be dented through the constant jumping of the shuttle, caused in the main by bad pickers, picking sticks, and bunters. Now, if those in charge had been doing their proper work, they could have heard the shuttle jumping.

What do we understand by the true

economy of labor? Using the right labor for the right grade of work, and getting out of that labor the best that is in them. Is it economy to fix a wage at $5, when by paying $6 you can have the choice of a certain class, and not having the choice, a $15 employe has to spend the biggest part of his time helping the lower priced laborer while seconds are accumulating. Is it economy to have the regular fixer do all his changing over, especially in mills where quick changes have to be made, and through this changing over have looms stopped two and three or more hours at a time? Is it economy to have a dirty room, through lack of help, especially if enough help can be obtained?

Look at the

VAST BENEFIT DERIVED

when the overseer, if not the second hand in addition, has time to make a careful inspection of the cloth being woven at least twice a week. In passing through the alleys he will readily detect little faults, and there are very few fixers but that

Fig. 121. Worn Picker.

are interested enough in their work to respect the person who brings to their attention the little things that would eventually lead to big losses. Of course, there is a way to do this so as not to offend. This passing around and through the room may not appeal to all, but there is nothing which will reduce seconds so quickly as this form of management, for very few weavers like to have the overseer or second hand point out faults in their cloth at the loom, and in addition it prevents that obnoxious method of calling the weaver to the examining board, although such a step is necessary sometimes.

Perhaps the above may appear foreign to the question of management as it is understood in these articles, but to the writer it is not so. The great and growing unrest among the work people demands consideration, and very careful consideration; and what has been written already deserves a place in the discussion of this mighty problem, for possibly mismanagement and a wrong conception of the true economy of labor has much to do with the unrest of to-day.

No. 257.

CCLVIII. HANDLING SUPPLIES.

Among the many things that enter into the management of a weave room is the giving out of supplies. Here a considerable amount can be wasted or saved, according to the manner in which the supplies are given out. For instance, in some mills, no account is taken of the supplies the second hand receives. All he has to do when his stock is low is to go and get all he wants, and the cost of said supplies is charged up to the weave room in general.

Another way in which the cost is kept high is in the ordering of picker sticks. These are often ordered in the bunch for the entire room, and are placed by the fixer's bench so that the fixer can help himself. The result is that the picker sticks are scattered all over the floor, and the chances are that a number will land near a steam pipe and get warped, and will have to be thrown away.

AN EXPENSIVE ITEM.

Shuttles are a very expensive item in a weave room. How often will a fixer get new shuttles before the old ones become worn out, or broken. Whereas, if he had to go to the second hand or the overseer, in fact, and show him the old shuttle

before receiving new ones, a considerable expense would be saved. A number of mills have a central supply room, where all supplies are given out, an account taken of where the supplies are delivered, and at the end of the month a report is sent in to the office and a duplicate is sent to the weaver, and the report is marked if an excess amount of supplies are used on any of the sections. A separate account is kept of supplies that are used for changing over. Usually

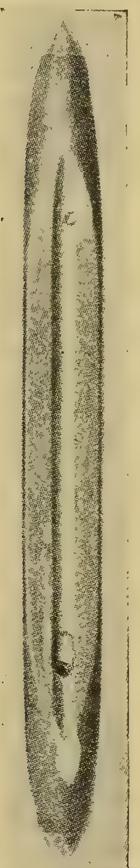


Fig. 122. Worn Shuttle Caused by Loose Binder Bolt.

when a mill decides to make a change from one style to another, advance notice is sent into the weave room so that the weaver can look up what he may need in order to make the change. The making of fixers is an important thing and one that is often lost sight of. In one mill that the writer has worked, the heads of the mill tried as far as possible to have their own fixers, giving encouragement to the young men employed in the mill, first by having them go around "smash piecing" and assisting the fixers in their spare time, then when a vacancy occurred or changes were needed, they were given a chance at changing over.

Sometimes when a regular fixer was out for a day or so, the changer was put on the section, thus getting experience not only in

CHANGING OVER THE LOOMS

from one style to another, but in running the section and then when a regular fixer was needed, one was raised up from the changers. In another mill an entirely different system was in use. Here they have fixers who do the changing over and who are paid more than the regular fixers. These changes are often what a boy or a learner could do, such as getting the harness straps ready, bending wires for the harnesses, etc., often not fully starting up a warp, but leaving it for the fixer on the section to finish. In this mill the majority of men on the sections have been weavers who were taken directly off their looms and put on a section without, practically speaking, any experience whatever The difference between the two mills is that in the first one the sections are kept in good order, with a high production, and low cost of supplies; while in the second case the looms are continually stopped for want of fixing, and the third hand, instead of helping out the second hand, is helping out the fixers, the weavers not earning anywhere near what they would earn under experienced men. No young men are employed in the rooms, because there is no encouragement for them, and the cost of the room is increased over what it should be in the line of repairs and supplies.

STARTING WARPS.

The above brings up the subject of starting up warps in which process considerable care should be taken.

A warp that has been put in the loom without any thought of how the harnesses are set is bound, sooner or later, to give trouble. Take, for instance, lenos: The doups with a little care in setting can be made to run for quite a long time, while if care is not used, one side being higher than the other, or the doup harness too high or too low, the doups can be spoiled in a very few minutes, so much so that before one or two pieces have been woven the doups have to be replaced. This means loss of production, extra added cost, more work for the section hand, and the chances are that he will get a few of these jobs ahead, and will have to get a spare hand to help him out.

While passing through a mill producing plain goods, I noticed quite a number of looms where the warps had been changed so that when the new warp was tied in, instead of using an apron to tie the yarn to, the fixer had torn the cloth so as to tie the yarn in order to start up the warp. It may not look to be a very large item, but when 12 to 20 inches of cloth is wasted in this way on one loom, it is not going to be very long before it amounts to quite a sum. The question is often raised, how is it that the looms in one room will turn off a larger production than the looms in another? Take, for instance, two rooms that have a cloth 43x35, 30 warp, 12 filling, 6-yard goods: In one room, the looms run at a speed of 172 picks per minute, while in the other room the speed of the looms is 188 picks per minute, and in each room a weaver tends to 5 and 6 looms.

THE PRODUCTION

of the room with the 172 picks averages 5 per cent more than the room with the 188 speed. According to theory, this should not be so but it is actually a fact.

There are a number of things to be taken into consideration. There are more possibilities of the yarn breaking out through the high speed than with the lower speed. The filling naturally will run out quicker, and unless the weaver is right on the job and the shuttles filled up, the looms will be stopped oftener, and will lose more than is gained by the higher speed. This is taking the room as a whole. Of course, there are a few weavers who will push the looms for all they are worth, taking advantage of higher speed to obtain more wages, but on the whole, these are exceptions. No. 258.

CCLIX. OBJECTS OF SIZING.

The object of sizing is to strengthen the yarn, so that without breaking it will resist the fraying action of the harness and the strain exerted upon it in weaving. Yarns for bleaching and dyeing should contain very little size, and then only of the best quality, otherwise the goods when finished will be faulty in appearance, as the yarns and floury admixture are differently affected in these processes.

Size to be applied to yarns should be of such a character that it will adhere to the yarn firmly not only while wet, but after the yarn has become perfectly dry. It should also retain its attachment to the yarn, even when submitted to the chafing action of the working parts of the loom with which the yarn comes in contact. Although no two concerns may be using the same mixing, the above-named objects should always be borne in mind when making up a mixing of size, whether it is for light, medium, or heavy sizing.

Many concerns seem to think that a mix of potato starch, or sago and water with a little tallow put in is good enough even for fine yarns and cambrics. A mix of this sort may be all right for coarse open weaves, constructed, say, from 20s warp yarn, 40 sley and 40 pick, but when we come to use 36s yarn and finer we want a better mix, one that will make a 36s yarn as strong as 26s, if possible.

Some overseers I have come in contact with reduce the water a little and have the size a little thicker and put in an extra pound or so of tallow, and then when a few warps have been put into the looms they would be asked if they had been sized heavy

enough, if not, they would be made a little heavier. I am speaking now of the aforesaid cheap mix when applied to fine yarns.

I often asked the superintendent to let us have

A BETTER MIXING

when using 32s yarn or finer. For a long time I could get nothing done, as the general manager had given instructions to each mill to use a special mix of his own invention. He always said they had no complaints from the other mills, which may have been perfectly true, as the other mills seldom used yarns finer than 27s, while our mill, being the newest and equipped with the latest new machinery, got the styles with the fine yarns.

Oftentimes we have made the fine cambrics with 38s yarn 90 sley and 100 picks and had complaints coming from the head office about the large percentage of seconds. I should not be wrong if I said half the order was seconds or rejects.

Beside the bad cloth, we were always sure to lose a few weavers when this order came round, as the weaving was so very bad from warp breakages. If a weaver had a pick out it was not often the loom could be started again without winding down until the soft place got through. I always contend that to cut expenses down to the lowest possible unit in the sizing department is false economy, as I said before, "bad sizing is positively certain to cause loss to a concern."

There is still

ANOTHER EVIL

arising from poor sizing, and that is the large amount of sweepings taken up in the weave room. This is due to the size not laying the fibres on the thread and holding them there until the yarn has passed through the reed and woven into the cloth. The sweepings are of very small value compared with their worth if they had been made into cloth. The size itself also falls off and will get into the bearings and dry up the oil, and very soon wear and clog the bearings and make the loom run stiff.

The looms in some weave rooms are as thick with dust and lint in one day as they become in other weave rooms in three or four days. This is due chiefly to the poor quality of sizing.

Another fault of the slasher man is the carelessness in the handling of the steam in the drying cylinders. When sizing coarse numbers, more steam is required in the cylinders to dry the yarn than in the case of fine ones. A good practical slasher man can tell from the feel of the yarn, as it is running on the loom beam, how much steam to use and also how to regulate the speed of the machine to get the best results.

If the yarn is run on the cylinders which are too hot and kept on the cylinders too long, there will be great difficulty in weaving the warp, as the yarn will have been "burned." The yarn will be

TENDER AND BRITTLE

and cause an excessive amount of breakages. On the other hand, if enough steam is not used the yarn is run on the loom beam damp. Should this warp lie in a warm damp room, it will develop mildew or fungi growth. Oftentimes this growth is so bad (almost black with it) that warps have to be taken out and the yarn pulled off the beam, sometimes to be cut off with a knife, and thrown away.

Too much care cannot be exercised in the amount of steam used and the speed of the machine. The quality of the loom beam plays a very important part in the making of good cloth. The spikes or projecting shaft in the ends of the beams become bent through long usage and

CARELESS HANDLING,

the wood roller will become slightly warped, and this will throw the flanges or beam heads out of square with the roller.

Beams of this kind ought not to be used until they have been put straight and square. We will, for a minute or two, look into what happens if a crooked beam is used. Should the spikes be out of centre, one-half the beam will be heavier than the other half. By half the beam I mean the

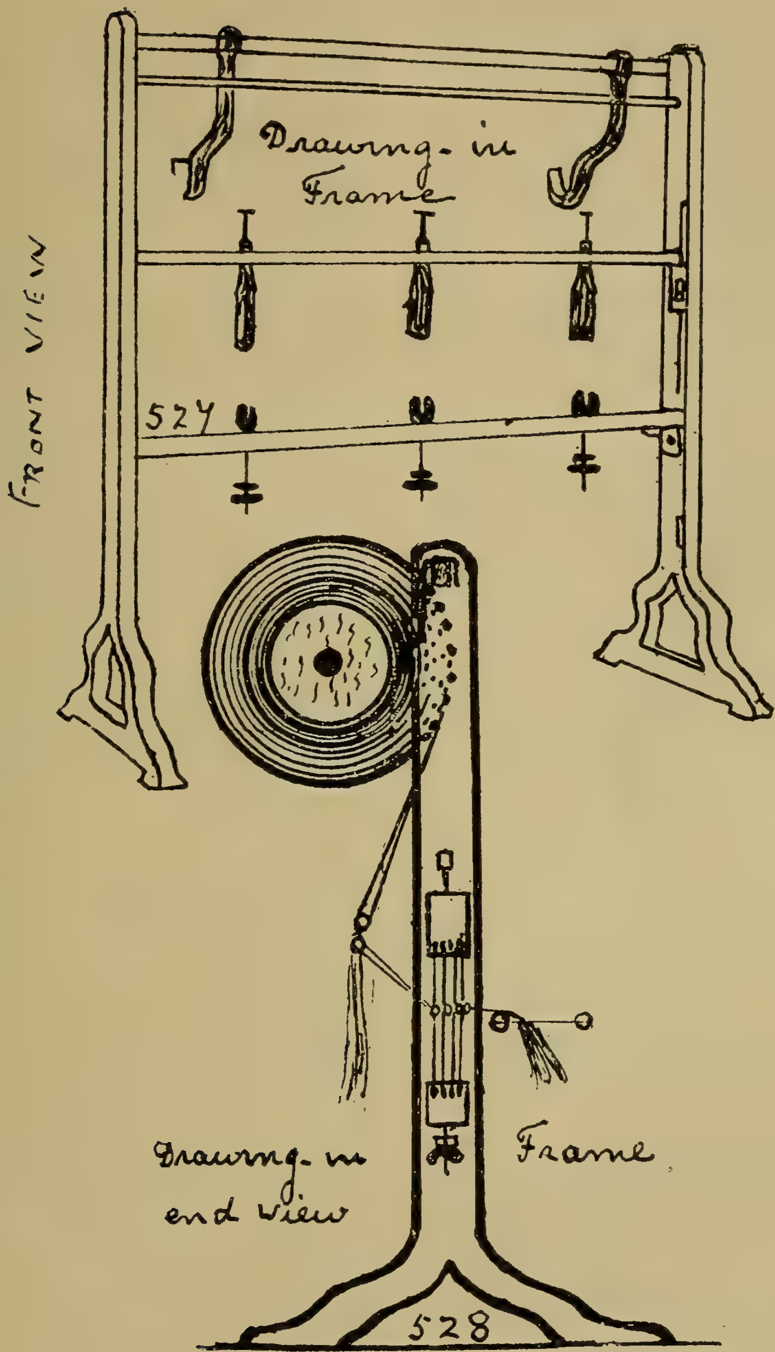


Fig. 124. Drawing-In Frame.

radius from the centre of the spike to the outside rim of the beam head. This will cause the beam to run around something like an eccentric cam. When the heavy side of the beam is moving on the downward side of the revolution, the cloth will be weaving slack and when the heavy side comes to the going up side of the revolution the cloth will be weaving tight. This will give cloth of uneven width all through the piece, beside difference in appearance.

If the beam heads are crooked, the yarn at the selvage will be

PILED UP HIGHER

than the body of the warp on one-half of the circumference and lower on the other half. Sometimes the higher part will be broken and cut by the press rolls under the beam in the slasher machine. In the weaving of a warp of this sort the selvage will weave tight when the lower side is coming off the beam, and slacker when the higher side is coming off. This will cause the cloth to look very bad when placed on the table, for a certain distance the selvage will be curly or crimpy and a corresponding distance tight and strained.

There is one very bad fault that slasher men are prone to, and that is the long distance they run down with threads wrapping on the cylinders or section beams. This makes it necessary for the weaver to "borrow" threads from the selvage, sometimes for days. A little piece of waste or a thread or two accumulating behind the raddle will cause a smash that will bother the weaver for many a day.

At two mills in which I have worked it was the custom for the slasher men to stop work at the end of a beam any time after 11 o'clock for their dinner. At 1 o'clock boil up again and start up, wasting about 10 yards or more of warp that has been in the size box and on the cylinders. When a set is put in the machine it ought to be run straight through, if possible, to get good results.

There is one more matter I want to touch on, and that is the striking of the combs for the use of the drawing-in room. In mills where a variety of styles are made it is necessary to have at least two counts of striking combs. A fine one for fine and high sley work, and a coarse or medium count of striking comb for the coarser numbers and lower sley.

Many times I have seen the slasher man, when he was running a fine set and not having a fine comb in his stand, put one of the coarser combs in, because he could not stop his machine to go round and find a fine comb. This would put from four to eight ends in one dent, and when the drawers-in picked out their ends from this comb we found that when the warp was put into the loom there was a difficulty in putting in the lease rods on account of the crossed and twisted condition of the threads.

This will cause many unnecessary breakages of yarn in the weave room, and be a source of trouble to the weaver all the time the warp is in the loom. Crooked and closed dents in the comb will also give the same trouble on account of too many ends getting into one dent. No. 259.

CCLX. DRAWING-IN ROOM

Very much of the success of the weave room depends on the careful handling of the warps in the drawing-in room. The system used largely for four-harness work is not the best one, that is, the one where the drawing-in girl hangs up the harness loosely in a frame, with the comb opposite the harness eyes, and after marking off the number of empty eyes on each harness stave, places her four fingers of her left hand through the open part of the harness underneath the eye through which the ends are drawn and with her metal hook proceeds to draw the ends in from the comb. For the first few ends she can get them straight, but the constant pulling out of ends from the comb has a tendency to slacken the other threads in the comb.

This is where the mischief is done, as when the yarn is slack it is al-

most impossible to pick out the threads in their straight order from the comb. The girl is on piece work and cannot afford to stop every dozen ends or so to draw the yarn tight in the comb, hence we get crossed threads in the weave room, which are a source of trouble through getting caught behind the lease rods or behind the drop wires of the stop motion. Seeing that all the threads are straight in

THE SLASHING MACHINE,

why not do everything possible to deliver the warps to the weaver in as straight a manner as when they left the slasher.

In Figure 124 we show a frame that will give good results. The framework is of cast-iron. The beam is wound up by means of a small traveling crane and put into the two bearings by putting up the beam, thus it is only necessary to have about half a yard of warp wound off the beam instead of having about two yards wound off when the beam is on two low stands on the floor. When too much yarn is wound off, the beam, it does not always get put back in the same straight manner that it was taken off.

Persons walking past the warp that is low down will sometimes accidentally rub against the yarn, causing it to roll over in the form of ropes, and if the warp is soft-sized and well-twisted yarn, it has a tendency to curl and twist in the form of ropes. Any number of harnesses can be hung in this frame and a thin wooden stave passed through the harness under the eye and drawn up by means of cord at each end until the right tension is obtained for the harness to slide on the wooden stave. A girl of about 14 years can do the work of picking the ends from the comb as well as an older person. The operative can use a double hook for the harness, taking in the first and third together and the second and fourth together. The reed can be drawn in at the same time by means of a thin piece of hard wood shaped as shown in Figure 123:

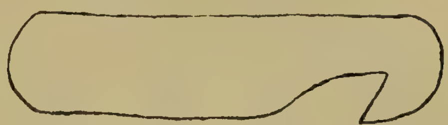


Fig. 123. Special Hook of Thin Hard Wood.

This can be manipulated by the left hand and pulled through the two threads, while the girl behind is putting two more threads on the double harness hook. A very high rate of speed can be obtained with a little practice.

Although the cost is a little more than for the single drawer-in, the quality of work is so much better and the extra production of weave room increased so that the little extra money paid for drawing-in is consider- to be money well spent. When a drawing-in girl leaves her work, there is always some one ready to promote from reachers to drawers, and thus the company is not bothered to teach raw recruits and have in a few days looms waiting for warps.

The man in charge of the room should be careful that no bad reeds are put on the warps until all necessary repairs have been made. Unless the harness is well looked after and kept tied up in sets, there is danger of getting wrong counts of harnesses together, and after a few hours' work and trouble in the weave room the warp must be brought back and drawn in over again.

A careless man attending to harness can soon cause a large amount of mischief and expense. A harness room is one of those places "where there is a place for everything and everything in its place." Each harness shaft should be stamped in plain figures the number of eyes it contains, and the spread, and the shelf where they are hung should be plainly marked, so that, should at any time the help in that department be changed, the new man would be able to find what he wants on the first day of his employment and not be

making blunders every day until he gets the hang of the thing.

NO SYSTEM OF MARKING.

I know of one mill that has no numbers marked on the harness, and the only recognition mark is a dab of paint of different colors on the end of the harness shaft or stave. Should the harness man leave and take his book with him, I do not know what would happen.

I do not know what the idea is for this system, unless they do not want anybody to know the counts of harness they use. The reeds were marked somewhat mysteriously, just the total dents on the end. The reeds ought to be marked with the number of dents per inch and the length in inches, beside the total dents. I rather like the system in vogue in England. Beside the counts marked on the broad dent at the end, colored dents are used in the centre of the reed, chiefly blue steel wire dents. If the reed was 48s, the three dents would be placed so that there would be four dents between the first and second blue dents and eight dents between the second and third blue dents. This is very useful should the ends get lost or the figures be indistinct. Care should be taken when tying up the warp after drawing in to tie up the harness and reed firmly to the warp, so that there is no danger of the harness slipping backward on the warp in the handling of the warp in the weave room. Should the warp have stop-motion pins or the long flat wire harness, much mischief can be caused through broken yarn.

In some mills

IT IS THE CUSTOM

to employ a boy to clean the harness as it comes from the weave room and pass it on to another boy, who repairs the ends and replaces broken harnesses (this is in regard to cotton harnesses). Suppose the boy who repairs the harnesses is careless and cuts off a few broken parts and does not replace them with new ones. This harness will not match up with three good ones, and when the set is drawn in and goes to the loom the warp yarn is found to be breaking too frequently, and on looking up the cause, it will be found that the warp yarn toward the edge is not passing through the harness in a straight line, due to one of the harnesses having had a few harness threads cut off. The only remedy for this is to cut the string or cord at the end of the shaft and let the harness slide in sufficiently to allow the warp ends to pass through the harness in a straight line. I do not think it pays in the long run to have a harness repairer, but if the money spent on his wages was put into new harnesses it would often give better results in the weave room and better satisfaction to all concerned.

No. 260.

CCLXI. FAULTS IN CLOTH.

The different kinds of faults that go to make a piece of cloth into what is called a "second" are numerous, and we will take them one by one and examine them closely and see if they cannot be remedied. The first we will deal with is one that is far too common, and is known in the cloth room and weave room as uneven cloth. Oftentimes the cloth will have a very cloudy appearance, as if some attempt was being made to make a plain cloth into a fancy cloth by varying the number of picks per inch of filling, that is, a stripe will run across the cloth from selvage to selvage very closely woven, and the stripe next to this will be very open and contain about half as many picks to the inch as the closely woven stripe. Without hesitation this can be put down as the fault of the loom and the loom should be stopped at once so that the fixer may put it right.

Very often it will be found that the beam is sticking somewhere, and when the tension of cloth becomes tighter, the beam, of course, has to go round, which it does with a lurch or jump and causes a thin place to appear in the cloth. If the loom has a friction let-off motion, the ropes may have become sticky and should be taken off and cleaned and a little powdered black lead rubbed on them. It may be that the ropes are put too

many times around the beam head and the grip is too keen. If the collars for the ropes or chains are separate from the beam head and fastened to the beam by screws, it may be found that one of the screws is coming out and catching a link of the chain or cutting into the rope. If the loom has an automatic

LET-OFF MOTION,

there may be some part binding or the spring which holds the pawl in contact with the ratchet toothed wheel may be too weak to hold the pawl firmly and will allow it to slip over a few teeth. With a little thought on the part of the fixer it can soon be found out what is wrong.

If the take-up gears are not working right, through the wheels being put too deep in the gear so that they do not go round freely, or not put in deep enough, allowing the driven wheel to slip back a few teeth at intervals, or the pawl which works from the sley sword and pushes round the ratchet wheel one tooth at a time becomes loose, or is moved a little, so that it may be pushing the wheel around one tooth, and sometimes two and sometimes none at all—these variations will cause the cloth to be uneven.

Some years ago the writer was called to a loom that had been making a thin bar once in a while and for which the fixer had spent many hours trying to find the cause. After looking over the let-off motion and take-up gears, and finding nothing wrong, he happened to be watching the whip roll (it was one of those used on the Draper loom), and noticed it worked backward and forward like a rocker shaft. On making inquiries, it was found that previously the loom had had a

STRONG CLOTH IN THE WARP.

This may not seem to have anything to do with the making of this thin bar, but it had, in this way: The loom was 54 inches wide, and the whip roll was not very thick and strong. The extra tension required to make the strong cloth had caused the whip roll to bend a little in the middle, and prevented it revolving. This caused the ends of the whip roll, which are in the bearings on the arms, to wear on one side only, leaving the roll in a bent condition; but when the tension was taken off, the roll appeared to be straight enough, so that the trouble was not detected.

Now that the loom had in a very light cloth, the whip roll would go around once in a while, and through the roll ends being worn on one side, it had a kind of an excentric movement. As will be understood, when the larger radius side got over the top centre, it allowed the yarn to slacken; hence, the thin bar. After having the ends of the roll turned down in the lathe, there was no more trouble. Sometimes on looking at uneven cloth, it will be found that the filling is not level, but is thicker in some places than others. This should be reported at once to the spinner, along with the spinner's ticket with the number of the machine on which it was made, so that the machine can be overhauled, and the fault remedied.

Far too many pieces are made into "seconds"

THROUGH CARELESSNESS

of the weaver. If the loom runs a few picks after the filling has run out, or broken, because the filling fork is bent and catches the sides of the grate, or the brake is not acting properly, a good weaver will get the loom fixed right away, while a careless weaver will continue with the loom out of order. When the loom stops from broken filling, or the shuttle runs empty, the take-up gears should be turned back a few teeth, so that when the loom is started up, the first pick of filling may be beat up close to the last pick put in before the loom stopped. If the wheels are not turned back, a thin bar will be made across the cloth, and if too many teeth are turned back, a thick or heavy bar will be made. It is the best policy to stop the loom just before the filling finishes, and change the shuttles, thus adding to the weaver's income, and making better cloth for the company.

In the common and cheap grade of cloth, thick threads are not ot much consequence, and are not very often complained about, unless the piece is very bad. When we come to the finer grades, such as lawns and cambrics, then the thick threads are not wanted, and everything possible should be done to keep them out. Some thick threads will go for yards and oftentimes through a whole piece and all through the whole of the warps in that set. When the thick thread goes through all of the piece it shows negligence on the part of the weaver in not having taken out the end and replaced it by one of the right counts or number.

This thick thread got in at the warping frame through carelessness on someone's part, by which a wrong bobbin got into the creel. The thick threads of few or many yards in length are caused by an end or thread breaking down in the spinning frame and the broken roving being licked in by the next thread, making that thread of double thickness and of a very hard and wiry feel. A good spinner will pull this thick part off the bobbin, while a careless spinner will let it go, knowing that once she has got rid of the bobbins it will be a difficult matter afterward to find the culprit. The frame tenders in the card room are responsible for a greater part of the thick threads that appear in the woven cloth. When a

BOBBIN RUNS EMPTY

on the speeder frames it is necessary to join the finishing end from the empty bobbin to the starting end of the full bobbin by overlapping the two ends and rolling them together between the thumb and first finger.

A good frame tender will not overlap the two ends more than half an inch, thus making a neat piecing, which cannot be found after it has gone through the different drawing-out processes to get the finished thread, while others will overlap the two ends as much as three inches, just rolling together in the middle. This kind of piecing will form an ugly looking thick place in the finished thread of anywhere from six inches to half a yard in length, according to the stage of the process when the piecing was made. Careless piecing of the roving at the spinning frames will make a thick thread of a few inches in length, and however much an overseer may insist on the weavers breaking out these thick threads before they are woven in the cloth, it is impossible to keep them all out. When the weavers can take them out it is a good plan to hang them up at some convenient place and the fixer or second hand to collect them once a week and send them back to the spinner and carder so that they can take the matter up with their help and have this fault remedied so far as possible.

SLUBS, OR LUMPY FILLING.

This is a fault that will often make a piece of cloth into a "second." The short slubs may be pulled out with care and the empty space scratched together by means of a steel comb, but the long slubs which reach all across the cloth, and sometimes for two or three picks, cannot be pulled out and the place scratched up, as the scratch-up often looks worse than the slub, no matter how much time is spent over it. There are various causes for lumpy filling, the chief one being that the weaver does not put the cop onto the shuttle spindle firm and tight, or, in pushing the spindle through the cop does not put the spindle through the centre of the cop, thus causing a few coils of filling to be on the outside of the spindle and when in weaving off, the filling does not break, but will come off the spindle in the form of a slub or lump. Oftentimes the point of the spindle will go through the nose of the cop a little on one side, and if the weaver does not pull a little of the filling off from the nose until it comes off the spindle straight, this will cause a long slub to weave in the cloth. If the cops are wound too slack in the spinning room, thus making a soft, spongy cop, they will cause slubs and lumpy filling. If the filling has not been steamed at all, or not steamed long enough, this will cause slubs to appear in the cloth. Too strong a pick on the

loom will knock off the filling in bunches.

SNARLS IN THE FILLING.

Snarls are somewhat of the nature of a slub, and are most frequent in hard twisted yarns. They nearly always appear on the opposite side of the loom to the starting handle, or on that side of the loom where the shuttle eye goes up to the top of the box. It is one of those faults that is very difficult to remedy. To give the filling a little longer steaming is a good remedy. To reduce the pick on the loom will help some, and open out a little the box front, so that the filling does not get pinched between the shuttle and box front, when the shuttle is coming out of the box. If the strength of the filling will allow it, put some lamb skin or a piece of flannel from the roller shop into the shuttle, so that a little drag may be put on the filling, in order that the snarls may be drawn out straight as the shuttle goes across the loom.

No. 261.

CCLXII. BAD SELVAGES.

No matter how well the cloth may be woven, a bad selvage will spoil the looks of a piece. If one of the harnesses is too low down, and the warp threads are hanging in a baggy fashion, when the shuttle is going across it will prevent the filling being drawn up tight to the selvage, and leave a short loop outside the cloth. Bad shedding, and not enough drag on the filling as it comes out of the shuttle, will make a bad selvage. Having the threads drawn through the harness wrong, or too many threads drawn through the last harness eye, will make a corded selvage, which, when put through the calender rollers, is liable to be cut and chopped by the pressure of the iron rollers. Some fixers believe in making a very large shed or opening for the shuttle to pass through. This will often cause a bad selvage, because the strain is so great at the fell of the cloth that it opens out the last few ends at the selvage, and prevents the filling being drawn up tight to the selvage. If the selvage ends on the beam are not level, but are built up higher on one half of the beam, and lower on the other half, through the beam head being crooked, this will make a bad selvage, as the tension of the selvage ends will at one time be slack, and at another time tight.

BOBBIN FILLING

always makes a neater selvage than mule filling, because it winds off the bobbin with very even tension, compared with the mule filling, which, on account of the small diameter of the shuttle spindle, and the bow-shaped spring necessary to hold the cop onto the spindle, causes the filling to wind off in a jerky fashion, noticed mostly in the latter half of the cop, and especially as the cop is finishing. The cloth woven at the finishing of a cop is slightly narrower than the cloth woven at the beginning. This causes the selvage to have a crimped appearance at the beginning of every cop. To remedy this fault, the shuttle spindle should be put as straight as possible with the shuttle eye and the spring flattened on the spindle as much as it will allow to grip the cop, or a thicker spindle should be used with the spring nearly flat. In this way the drag at the bottom of the cop will be reduced, which will prevent the cloth being pulled in narrower.

REEDY CLOTH.

Reedy cloth is that which shows an empty space every two warp threads all across the cloth, or if the warp is sleyed three in a dent, a mark will be seen every three ends. Sometimes it is necessary to draw in the warp one end per dent of the reed to overcome this fault, but this only should be done on coarse work. When the sley counts get beyond, say, 50 ends to the inch, it is not practical to use a reed with one end per dent, but it is necessary to so set different parts of the loom to overcome the reed marks in the cloth. If the breast beam is a movable one it may be raised a little, say, half an inch, but if the breast beam is a fixture and cannot be raised, a wooden lath or stave from the old harness will do, which

is fastened on top of the breast beam under the cloth. This will raise the cloth up to the required height. If, after weaving a few inches of cloth the reed marks still show, the back bearer or whip roll may be raised half an inch, and woven a few more inches. By this means, when the shed is open, we get the bottom half of warp threads tight and the top half slack. This causes the warp threads to break oftener and reduces the production of the loom.

Sometimes a fixer will lower the harness until the warp threads are sawing nicks in the lay board. This will sometimes stop reediness, but will cause more trouble by making other warp threads break, beside spoiling the lay board by making nicks across it, which will need planing off when the loom is empty, afterward causing the shuttle to travel across crooked and become injured. After the top shed has become slack, the shuttle must be made to travel very straight and true, or it will fly out and be dangerous to the help in the room, or it will pick over a few ends at the side and spoil the cloth. A very good and simple way to stop reediness is to move back the harness roll bearings on the loom top about an inch and bring forward the jacks on the treadles two or three notches. By this means we get a

TIGHT BOTTOM SHED

through the eye of the harness being nearer the lay board when at the bottom, and as the eye comes up to make the top shed, it moves slightly further away from the fell of the cloth, and thus draws up the slack threads which would otherwise hang down in the shed in the way of the shuttle. In making this alteration we have not put so much strain on the yarn as when the back bearer or breast beam is raised, so that reediness may thus be cured without causing more warp breakages. On looking at A, Figure 125, it will be noticed by the upright position of the harness that the harness eye is furthest away from the fell of the cloth when it is down at the bottom. It will be clearly understood when we say that the harness eye comes to the top, that position being nearer to the fell of the cloth, it will allow the thread to become slack in front of the reed. In B, Figure 125, the sketch is rather exaggerated to illustrate our meaning.

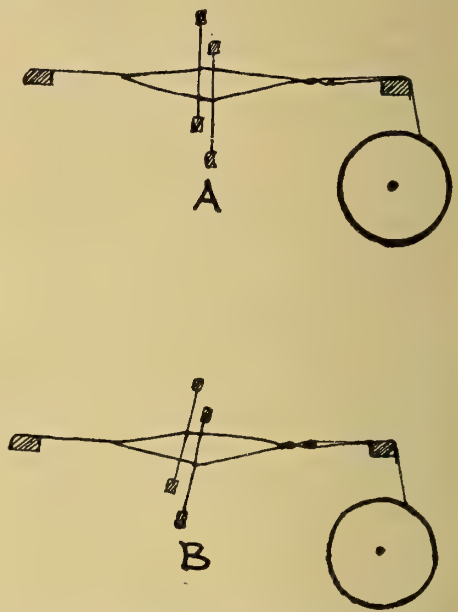


Fig. 125. Sketches Showing Cross Section of Harness.

When the harness eye travels from the bottom to the top, without going further away from the fell of the cloth, it takes up the slack yarn from the front and puts it at the back of the harness, where it can do no harm, and leaves a clear shed for the shuttle to pass through. No. 262.

CCLXIII. YARN BREAKAGES.

Nothing looks worse than a piece of cloth with yarn breakages through the piece. It is lamentable, but nevertheless true, that excessive breakages of warp yarn are far too common, and it may safely be stated that in the majority of cases they are a disgrace to the management of the concern.

Not once, but many times, when it has been necessary to take a complaint to the spinner and superintendent about certain styles weaving very

bad for warp breakages, this kind of a reply was received: "Well, the yarn is the same as we have always made, and I don't see why it does not weave all right. You want to fire out two or three of those loom fixers, they always seem to be sitting down when I go through the room, instead of fixing the looms." Of course, the setting of the loom has a good deal to do with warp breakages, but if an overseer and the second hands are capable men they will see that the loom is set in the best possible manner and everything done that can be done at the loom to reduce the warp breakages before any complaint goes to the superintendent or spinner.

THE CHIEF CAUSE

of warp breakages is weak yarn. The yarn may be weak from three different reasons. First, there may not be enough size on the warp, and what is on may be of a poor quality and not binding the fibres firmly together. Second, the warp threads may be of uneven thickness, caused by something being out of order in the different drawing-out processes of the spinning department. Third, the yarn may be weak by being spun from cotton of too short a staple, or mixing a few bales of short staple cotton with the good staple in the picker room. Reason No. 1 and 2 can be remedied without much difficulty, but it would be far better if they did not exist at all. It is getting rather late in the day to try to make a few thousand pounds of weak yarn good after it is put on the yarn beam and going into the looms, whether it be from poor sizing or uneven and poor spinning. Reason No. 3 is one that is more difficult to handle, as the cotton from different bales varies in length of staple. Unless every bale that is opened is tested for length of staple, there is always a danger of some short staple cotton going in the wrong direction, that is, going for warp yarn when it ought to have gone for filling.

Bales have been opened that have been bought for an inch and one-eighth staple, and you could scarcely call it an inch staple. If this had been put in the warp yarn mix trouble would have been the result, with weak yarn. It would be time well spent if the carding master would spend a little of his time in sampling the

STAPLE OF THE BALES

as they are opened. Some carders do, and others do not. Where the carder looks well after this point, there is bound to be good spinning and good weaving, and where the carder is careless and indifferent about this point there is bound to be bad spinning and bad weaving.

It is unnecessary to say that it is always the carder's fault when the work is bad, as the cotton buyer is often responsible, by buying a grade or two cheaper cotton so that the profits of the concern may be swelled a little larger. It has always seemed true that if a warp cost nothing and it would not weave moderately well and make good cloth, it is dear as a gift.

The up-to-date mill is fitted with suitable machinery to spin fine numbers of yarns, as well as the coarse and medium numbers, to suit the different styles of cloth the market may demand. Some of the older mills were put down to spin coarse and medium numbers, but as time has gone on they have had to drift into the finer counts to keep the mills going and by tinkering and altering the machinery have started to spin finer numbers. Although this may be done with success sometimes, when there is a good staff of capable men in the mill, oftentimes it is a failure as far as the weaving of the yarn is concerned.

When a warp has been started up in the loom and is found to be very tender and breaking too many threads,

THE SHUTTLES

should be looked at to see if there are any rough places or chipping away of the wood through the shuttle's not traveling straight and knocking against the shuttle-box front on entering the box. The shuttles should be taken to the bench and planed up until the back and bottom

of the shuttle is perfectly straight and thoroughly smoothed up with sand paper, and if the point of the steel shuttle tip has become blunt it should be ground to a point again on a grinding stone. Alterations should then be made at the loom to make the shuttle run straight, such as lining up the back box plates with the reed, and, if necessary, put on new pickers on the picker sticks, care being taken to gouge out the hole in the picker in the right place and set the picker stick so that it lifts the back end of the shuttle up about a sixteenth of an inch when the picker is delivering the shuttle. The shuttle must be thrown straight, or excessive warp breakages will result. As much of the cover, or troughing between the whip roll and the breast beam as will allow, should be taken off, so that instead of a tight bottom shed and slack top shed, which puts a great strain on the yarn, a shedding of more even tension may be obtained. A little of the cover from the cloth must be sacrificed in order to help the warp to weave.

A great help toward making a bad warp weave is to have a

VIBRATOR BACK REST

or bearer instead of the single roller which is very much used. If all plain looms were fitted up with this vibrator device, much better results would be seen, as the cloth looks fuller and of better cover, also the warp weaves better, producing better cloth and a little more of it. For the benefit of those readers who have not seen it in operation, it will be as well to explain its uses.

The vibrator consists of a long round shaft resting in two bearings like the ordinary back rest, with a cast-iron arm screwed on at one end and reaching on to an eccentric cam loom side a stand is fixed on the long shaft at each side of the loom to carry a shorter shaft. As the crank shaft revolves, the eccentric cam on the crank shaft. Just inside the lifts and lowers the arm and gives to the back rest a rocking motion. For instance, on looking at the loom with a fixed back rest, and turning the loom until the harness has opened the warp for the shuttle to pass through, if we feel at the tension on the yarn, it will be found to be very tight, and then on turning the loom until the harnesses are level, and again feeling at the tension on the yarn, it will be found to be very slack. This sudden jerk on the yarn from slack to tight every pick that the loom is running is bound to cause breakages of yarn, especially on tender or fine yarns. Now we will take a loom that has a vibrator back rest, and do exactly as we did with the other loom. When the harnesses are fully open, the yarn is not found to be unduly tight, because the eccentric cam has lowered the arm and allowed the top part of the back rest to move forward sufficiently to slacken the yarn from the beam, to counterbalance the opening of the yarn for the shuttle, and as the harnesses are put level the eccentric cam lifts the arm and allows the top part of the back rest to move backward sufficiently to take up the slack yarn caused by the leveling of the harness. By this motion one gets an even tension on the warp yarn all the time the loom is running, instead of the jerky tension of the other loom. This is bound to have its effect on the yarn and make it weave better.

No. 263.

CCLXIV. HUMIDITY OF THE WEAVE ROOM.

Another very important part of the weave room to get good weaving is the humidifying of the air. No weave room should be without a good humidifier. Many weave rooms just blow out a little live steam from the boiler. This is not only injurious to the people who work in the room, but it raises the temperature of the room very high, and then the steam must be shut off and windows and doors opened to cool the room. Not very good results have been observed from this system, as the temperature and humidity varied too much. What is wanted is a constant supply of damp air being blown into the room all the time the room is in use.

Yarn that is sized in a dry atmosphere is brittle and easily broken by the working of the loom, while in a damp atmosphere yarn is pliable and elastic in its feel, and will bed itself into the cloth better than when it is dry and brittle. Oftentimes when everything has been done to the loom to reduce the warp breakages, the warp will still weave very badly. The only thing that can then be done is to see if there are any other styles of the same sley and warp counts and width, of lighter weave, to which it can be changed. This will often tide over the difficulty and enable the bad warp to be woven up.

FLOATS.

A float is a hole in the cloth where the warp and the filling have not intersected over and under each other. The filling may be loose on the outside of the cloth, or the warp yarn may float over the filling. A good weaver will have few floats, while a poor weaver may have many, ranging from one inch to a yard long, and sometimes more. Floats are caused chiefly by an end, often the beginning part of a thick end, breaking in front of the harness and getting entangled with a few more of the other threads and not allowing the ends or threads

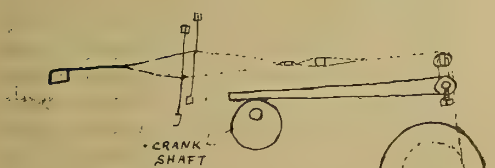


Fig. 126. Vibrating Back Rest.

that are entangled to open out for the passage of the shuttle. A weaver who is attentive to his or her duty will detect the float early and straighten out the broken thread and unweave the float, and thus make the cloth good again.

The weaver who is watching the work of some one else and neglecting his own will allow the float to weave on and on, and sometimes change the shuttles and start up the loom with the float still weaving. An attempt is made after the float has been found to scratch the place together with a steel comb, and with the aid of a little oatmeal and water or a rub-over with some white soap to stiffen up the soft place caused by scratching, and to fill up the open intersections, so that they may cheat the inspectors in the cloth room and

ESCAPE A FINE.

Should these scratch-ups go through and the cloth be passed as good, the person who buys the finished garment with a scratch-up in it will be the loser, because the scratch-up will soon wear into a hole. Any observer walking through a weave room will find a few weavers who are continually going behind the looms to pull down a few ends belonging to the selvages, which they say won't weave. This kind of talk is nonsense. You don't find this kind of thing among the good weavers. It is only the poor and careless weaver who cannot weave unless the fixer is always at the looms and the spare hand straightening up the crossed warps. An endless number of floats and smashes are caused by throwing down the back of the beam ends to weave out until they are long enough to draw in without piecing up, or because the end has broken out once before. Should the weaver neglect to go behind and pull the ends down they get fast behind the harness and either break out a lot more ends or make a float. One does not, as a rule, find this kind of weaver earning good pay or making very good cloth.

MIXED FILLING.

At any mill where a large range of styles are made, it is a difficult matter to avoid wrong filling getting into the cloth. If it is at all possible, arrangements should be made whereby each loom can have a box of filling to itself. This prevents, to a large extent, the possibility of a weaver dipping into the wrong box. Where the looms are driven from underneath, it is an easy matter to give each loom a box of filling, as there is plenty

of room between two looms to fix a stand to carry two boxes. If the looms are driven from overhead, it is a difficult matter, as the belts are in the way of fixing two boxes, and the space between the belts will only allow of one box. When only one box can be put on the stand for two looms, the best system to adopt is that of matching the filling on the two looms with the starting handles together, either with the same style or styles with similar counts of filling.

Everything possible should be done not only in the arrangement of filling boxes, but everything else in the weave room that will make it difficult to do wrong and easy to do right. Although the weaver is often blamed for a wrong cop of filling, the spinner may have accidently put a few cops in of another count, or the man who took away the boxes from the spinner may have spilt a few cops on the way and another person seeing them may have picked them up and put them into any box conveniently at hand.

GREAT CARE USED.

Every person who has the handling of filling should use great care, so that there is little danger of cops going astray from one box to another, or the spinner's ticket getting lost from its own particular box. The cop with the spinner's ticket on denoting the counts, etc., should be left in the box by the weaver until the last, so that the overseer or second hand on looking in the box may know what count the filling is, not only for that, but if a fresh warp of another style is put in the loom and the filling changed, the box may be taken back and put in its right place. Although the boy who takes the filling to the weaver is supposed to give out the right counts only, he is liable to make a mistake, like all human beings. To guard against this, it ought to be the weaver's duty to see that every box given to him or her is of the right count.

It is a common practice among weavers, when the counts which they ought to use are not very good, or the supply is short, to get the next counts and either throw away the spinner's ticket from the box or change it for one of the counts they ought to use. Practices of this sort throw out the standard weights of the cloth and oftentimes makes things unpleasant for the overseer. No. 264.

CCLXV. GREASE IN THE CLOTH.

Many times a piece of cloth is spoiled by having black oily spots at intervals throughout the piece. Sometimes it is a black oily piece of waste woven in the cloth, leaving a long trail behind it, like the tail of a comet. This kind of dirt generally comes from an unclean shuttle box, and sometimes it will drop from the ends of the harness roll shaft, or any other form of head motion. The weaver who keeps the head motions and shuttle box clean is seldom bothered with black lumps weaving in the cloth.

There are far too many weavers who are satisfied to blow the dust off the looms, or just touch them over lightly with a brush, and then pour on the oil. In the olden days all machinery in a cotton mill was

CLEANED AND SCRAPED

every week, as if for exhibition. The cloth in those days must have been very clean when taken from the loom. At the present time, it seems to be a matter of making dividends, regardless of the condition of the machinery. The machinery must be run the full number of hours allowed by the state, and oiling and cleaning must be wedged in as best it can. Black oil from machinery contains iron, and when bleached will leave a reddish stain. Another form of grease which spoils the cloth is the small specks of oil thrown off the cams onto the warp. These spots of oil sink into the warp for a considerable distance, and will sometimes weave so far as twenty yards all specked with oil.

A bad fitting crank shaft, or loose crank arms, will throw out the oil. When oil is thrown out from the crank shaft bearings, it is a difficult thing to remedy. The shaft is generally about seven one-thousandths of an inch smaller than the bearing, and with the jerky motion of the crank shaft when the loom is running,

causes the oil to be thrown out every time a few drops of oil are put in the bearing.

This system of making the shafts smaller than the bearings is carried out all through the loom, and is for the benefit of the loom builders only. It enables a man to fit on the bearings quicker and thus

TURN OUT MORE LOOMS

per week and at a smaller cost. The best crank shaft for cleanliness and long life is one that is bushed with a cast-iron sleeve at the place where it rests in the box or bearing. It is much better to have two surfaces of cast-iron in the bearings, instead of the customary wrought-iron shaft, as the wrought-iron wears away very quickly, being so much softer than the cast-iron. To get good results, it is very important that there be no play in the crank shaft bearings.

There seems to be a tendency at the present time to run the looms at a higher speed than formerly. Where the looms have been speeded up, the management must not grumble if the cost for repairs is higher and the quality of the cloth much worse. High speed will cause the looms to bang off oftener, and this is what causes breakages of loom sides and other minor castings. Should the shuttle be caught in the yarn, there is danger of a number of the warp threads being broken.

We have found from experience that a loom making 36-inch cloth with a 40-inch reed space, underpick loom, will run best for all concerned at 180 picks per minute. An overpick loom will stand 10 picks per minute faster than an underpick loom, because a much smoother pick can be obtained on the overpick loom, the pick on the underpick loom being short and somewhat jerky. For every extra four inches of width in the loom reduce the speed 10 picks per minute. When using coarse filling such as 10s or thicker, a much slower speed is advisable. If the loom has a jacquard or dobby head on, a slower speed is advisable, according to the counts of yarns used and the strength and weight of cloth being made.

Taking everything into account,

THERE IS NOTHING GAINED

by high speed of looms. We had an experience in this a few years back, while working at a mill where the head man was a great believer in high speed. Every machine in the mill was speeded up to its utmost and far ahead of any other mill. The result was weaker and uneven yarns. The engine that ran the weave rooms was separate from the mill engine, and this was altered to run a little faster, which put about 12 picks a minute more on the looms. The 40-inch reed space looms were going over 200 picks per minute, some as high as 210. The expenses for shuttles and other repairs went up by leaps and bounds. After several consultations, it was decided to reduce the speed lower than we formerly had it. The superintendent argued that lowering the speed would reduce the production and cause the weavers to ask more money for weaving. We contended that the production would not be lowered. Strange to say, after the speed was lowered to about 180 to 185 picks per minute, the average per loom went up higher than ever before in the history of the mill. This was because the looms were

ALWAYS ON THE MOVE,

instead of being stopped waiting for the fixer or taking in warp smashes, and repair expenses went down. Instead of finding about half the looms stopped on walking through the room, one could see nearly all of them going and the weavers were leaning against their looms with arms folded.

After this demonstration, you could not convince this superintendent that high speed was a good thing for looms. At a mill where a large variety of styles are made, it is a good investment to buy a few pairs of larger pulleys, so that when a style is put into the looms with coarse filling, especially if the filling is soft spun, the loom may be slowed down about 20 picks. The cloth from the loom, after decreasing the speed, will be found to be much better than from a loom

of the original speed. The production will not suffer, because the weaver will be able to watch for the end of the cop and change the shuttles before the filling runs out. There is nothing which spoils the cloth so much as bad starting places after the filling has run out and the loom compelled to stop.

Where a cop of filling only lasts about three or four minutes, it cannot be expected that the weaver will see the finishing of every cop, when there are other looms that require his or her attention. Reducing the speed helps a good deal, because, beside making the cop last a little longer, it also reduces the pick on the loom and causes the latter to run smoother. This enables the cop to weave from start to finish without danger of splitting the cop or breaking the filling, and also prevents, to a large extent, the filling being thrown off the spindle in thick bunches and spoiling the cloth from slubs.

SHUTTLES.

As shuttles play such an important part in weaving, it is best to adopt a good standard make of shuttle for use in the looms. The shuttle should be of well-seasoned hard wood, with a straight grain; each shuttle should be of uniform weight, as a heavy shuttle and a light shuttle will not run well together; the heavy one will go across with greater force and rebound in the box, while the light one will go across too slowly and occasionally cause the dagger to strike the frog and knock off the starting handle.

The shuttle should be of such a shape at the ends that it lifts the dagger gradually, instead of lifting the dagger to its fullest extent as soon as the shuttle strikes the binder. A shuttle should be adopted that will put sufficient drag on the filling when weaving to make a clean and straight selvage.

Some mills are constantly changing their shuttle makers and will have as many as half a dozen different patterns of shuttles in use, not only in regard to shape but also size. In mills of this sort it is sometimes a difficult matter for the fixer to keep account of the different treatments required to make the loom run good. Most mills adopt a square shuttle, that is, one that has the shuttle front as high as the back. In our opinion, this is wrong, as every one knows that when the shed is open to receive the shuttle it is wedge-shape and not square. If about three thirty-seconds of an inch was taken from the depth of the front and put on the depth of the back, much better results would be obtained in connection with weaving of the warp yarns and less friction would be placed on the shuttle when passing through the warp to the other side of the loom.

Another very important part of the shuttle is the spindle to carry the cop. Each spindle must be of the same thickness and taper as the mule spindle on which the cop is spun. A good one of the right gauge should always be sent to the shuttle maker when ordering a supply of shuttles or shuttle spindles. When the shuttles or the shuttle spindles are received at the mill each one should be gone over carefully and the thickness of each tested by a steel gauge.

A good gauge is made by taking an old file and breaking a piece off the thick end about three inches long, after the roughness of the file has been ground off on a grinding stone. Drill three holes of a size which will allow the spindle to go an inch through the small hole, the second hole to allow the spindle to go three inches through, and the third hole to allow the entire spindle to pass through. The spindles which do not come pretty near the measurements required

SHOULD BE REJECTED

and returned to the maker. This is the only way to get at the maker and obtain what is right.

If spindles of the wrong thickness are put into use, there is bound to be trouble from excessive waste. The thick ones will, in trying to press on the cop, break the filling inside the cop (if it is fine filling), or leave the nose of the cop outside the spindle, which the weaver must pull away to waste in order to get the filling to

come off from the spindle. The thin spindle will allow the cop to slide so easily that it has very little grip on the cop at all, and will, when put into the loom, either slip off in lumps or the cop will break in the middle. When the cop has broken in the middle, all of it must be thrown away, so that if we look at the question intelligently, it shows us that it pays to look well after the gauging of the shuttle spindles. No. 265.

CCLXVI. TEMPLES.

Seeing that about 99 per cent of the cloth woven requires to be woven with temples, it is very important that one be selected that is best adapted for the grade of cloth being made. If a cloth is being made that contracts a good deal from the reed to the breast beam or front rest, it is advisable to have a good temple with a roll in it which carries about 10 brass rings, each ring to be well filled with fine steel pins, the rings being on the shaft or roll at an angle of about 50 to 60 degrees. This enables the cloth to be held in the temples at nearly the same width as that at the fell of the cloth or the width in the reed.

Should a temple be used which does not hold the cloth out to the full width, while the reed beats up the filling, there

WILL ALWAYS BE TROUBLE

to make the warp threads at the selvage weave without constantly breaking out. Beside that, the friction on dents of the reed is so keen that before long a nick appears on the side of every wire dent for about half an inch at the selvage. Sometimes the wire dents will be cut so badly that the dents will break in the middle and the reed on this account will have to be discarded or used on narrower goods. As the points of the steel pins break off or become bent, the rings must be replaced with new ones, or the quality of the cloth will suffer on account of what is known as temple marks. This marking is caused by bad pins on the rings, which cut or break a warp thread at intervals, sometimes so badly that the piece has to be made into a "second."

Lighter grades of cloth which do not contract very much can be made successfully with a temple which carries one, and in some cases two, solid iron rollers which have their surface cut in the form of sharp burrs. These slight projections are sufficient to hold light cloths and do not mark the cloth with small holes, such as would appear if a ring temple was used. If the temple has no heel to strike the front of the lay beam and protect the reed, care should be exercised when setting the temple that it does not strike the reed, or the dents of the latter will be spoiled, and cause yarn breakages, also the reed must be thrown away, thus adding to the expenses of the weave room.

Some firms use a temple that goes all across the loom, having a steel-cut roller the full width of the cloth.

FOR SOME KINDS OF CLOTH

where the picks of filling are required to be in one straight line across the cloth, this kind of temple is necessary; but for ordinary cloth, such as greys, print cloths and bleachers, we do not favor the all-across temple, as too much strain is put onto the warp yarn when the shed is open, the shed that is down being very tight and the one that is up being very slack. This is because the temple holds up the fell of the cloth very high, on account of the temple cap or cover being underneath the cloth, and must be set to clear the lay beam.

If a piece of cloth be taken that has been woven with side temples and a straight edge put on and trace a pick of filling across the cloth, it will be found that the filling will go about half an inch out of a straight line. but this cannot be overcome with the side temple, and for all ordinary purposes, it is no detriment to the cloth, as the defect is rarely noticed, unless the goods are checked materials, then the colored stripes will be seen to run out of a straight line.

HARNESS YARNS.

In the weaving of fine yarns or cloth with a high sley, the counts or

thickness of the yarns from which the harnesses are knit play a very important part if the warp must weave well. It is necessary that all the space which can be should be given to allow the warp ends to pass each other, when forming the open shed, with as little friction as possible from the outside of the harness eye.

Many mills order a thick yarn for all purposes so that the harness will last a long time without renewal. This is a mistake, as the life of the thick harness yarn is not much more than the fine harness yarn. As soon as the varnish is worn off the yarn, the harness eyes soon begin to break and cause trouble. Oftentimes we have noticed as long a period as two days being spent by the fixer and weaver in starting up a warp with new harness when made from thick yarns. If the warp is anyway soft, the warp will always weave badly. We had trouble of this sort at one time, and after repeated entreaties to the superintendent, we had some harness knit from fine yarns and the result was like magic; the warps went through without a bit of trouble, and styles which the weavers did not like before were in demand.

Although

MUCH CAN BE SAID

in favor of the wire and steel harness, we doubt if there is anything superior to the cotton harness for good results, when the harness is knit from fine yarns made with a long staple cotton and smoothly varnished. It is claimed that the wire harness will last indefinitely, but put down its cost and the cost of treading the eyes with a band every time they must be drawn into another pattern or style and the putting on and taking off the heddles for the same purpose, against the cost of buying new cotton harness, and we doubt if there is much saved. However, as this is a matter where opinions differ among mill men, it should be left to the judgment of each individual. No. 266.

CCLXVII. WEAVE ROOM STORES.

The system that seems most popular among mills is that of charging up to the weave room the entire cost of each article as it is received in bulk. On the face of it, this may seem all right, but when we come to look at the question more carefully, it is very unfair. For example, take the shuttles, as this is the

MOST EXPENSIVE REPAIRING

article used in the weave room. The company may buy 500 shuttles at once. When received in the general store room of the mill, they are charged direct to the weave room repairing account, and if the wages and cost report is made out every four weeks, it is quickly noticed that the cost side of the report has gone up, and may bring down comment from the superintendent or other high official, asking why the cost of running the weave room has gone up higher than the previous month. Of course, the weaving overseer has got to explain the reason.

If each article of weave room stores for repairs was booked, and the quantity taken out of the store room charged up to the weave room at the end of each month, a more evenly balanced expense report would be seen and would be found more reliable for reference as to the cost of each article. At one well-known mill the overseer must go to the general store room on one particular day in each week and at one particular hour and get what he thinks he will need for the ensuing week. The supplies which he receives are put in a lock-up room made under the stairway. Each second hand, beside himself has a key for the door, and if a fixer wants a new pair of shuttles, or a few pickers, or picker sticks, or any other commodity for repairing his looms, he seeks the second hand or boss weaver and asks for the article wanted, and even though the second hand is located some distance from the small store room, he is expected to go and

SUPPLY THE FIXER

with what is required. This is because the company disapproves of the fixer having any stock at his bench.

It would be much simpler for the boss weaver and his second hand if

the stores were given out to the fixer in the same way as they are given to the boss weaver, that is, once a week at one particular time. The stores given out to each fixer should be entered in a book and about once a year a report made out, showing what amount of stores each fixer had used during that time. When this is done, it will generally be found that it is the same fixers each time who use the most shuttles and pickers.

From a report of this sort the overseer can soon form his own opinions of the fixers under him, because a poor fixer always uses about twice as much in the way of supplies as anybody else. Some mills have a rule that each fixer shall have one pair of shuttles a week and no more; other mills allow two pairs. A good deal depends on the age of the looms and the class of work engaged in as to the amount of shuttles one can get along with, but it can easily be figured out by looking up the back totals for a few months and striking an average. Pickers, leather, etc., can be given out in the same way.

To create a desire for economy among the fixers,

A GOOD PLAN

is to allow a certain amount of supplies each week and at the end of perhaps three months, pay the fixer a certain price for each pair of shuttles he can return to the store room. A good deal depends on the quality of work a fixer does as to the amount of supplies he uses, and a feeling of carefulness as well as of efficiency cultivated among the fixers is a good thing for the company. Some mills go to the extreme in trying to save a little on the stores. There is one mill in particular where, if a shuttle breaks, instead of giving the fixer a new pair, the overseer will give him one shuttle and tell the fixer to plane it down to the size of the other one. If a picker breaks, the fixer must show the broken picker and receive a new one. This could scarcely be credited were it not known to be a fact.

To keep looms in good condition to get good production, repairs must be done with good material at the proper time and not a constant patching up with a nail here and a rivet there to hold broken parts together. This cannot go on very long before the company begins to suffer. Men of experience in that particular branch of the business are wanted for the positions of overseers and second hands not only in the weave rooms, but in every department—a man whom the company can rely on to use judgment in all matters concerning his own department.

Instead of the overseer being ruled by the clerks in the office, as is

SOMETIMES THE CASE,

let him choose the kind and quality of all goods required for his own department. If this were done, much better results would be obtained. Take, for instance, the shuttles. How often has the weaving overseer a voice in deciding what sort shall be used and where they shall be purchased? The shuttle maker who can quote the lowest price generally gets the order, regardless of quality.

Leather is another article where cheapness often goes before quality. Parings from the edges of hides after the belt maker has taken all the good away is generally bought for the weave room. It is often of very poor quality, and does not last very long for any use to which it may be put. The very best quality of leather pickers should be secured. They may cost a trifle more to buy, but a good picker will last as long as two or three of the cheap makes. Those using the leather loop picker know that

WHEN THE PICKER BREAKS

it has a tendency to turn a quarter way round on the stick and hold out the binder, and when the shuttle goes into the box at the opposite end it rebounds into the warp and the loom weaves over with the shuttle in front of the reed; this means that nearly every end is broken the entire length of the shuttle. If only to prevent this difficulty, the very best picker that is possible to purchase should be obtained.

When new shuttles are received

from the maker, they should be put to soak in raw linseed oil, or neat's foot oil, for about a week, and then taken out to drain dry on some wire netting put over the soaking tank. After the oil is well dried in, they are ready for use. After treating the shuttles in this way they will last about half as long again as when used dry when they come from the shuttle maker. The shuttle not only wears very smooth, but there is less liability of it chipping and causing smashes. The spindles should be

GAUGED FOR THICKNESS,

and those which are not of the required thickness should be sent back. If mill officials would see that plenty of good material was provided to repair the looms they would not be troubled so much with their fixers leaving to go to other mills. A fixer who has a section of looms to look after has sufficient work if he does his duty, without spending so much of his time patching up for the want of new material.

The cop waste is always a serious point at all mills where the filling is made on the mule. The best system

TO HOLD IN CHECK

the excessive waste made is for each fixer to collect his own waste each day in a bag or basket (basket preferred). He can then see who the weavers are who make too much waste and caution them about it and look over the looms to see if anything is out of order. After the fixer has collected his waste, he should take it to the waste house and have it weighed and have the weight in pounds put opposite his section number. When this is totaled up at the week end, the weight from each section is readily seen and a suitable comment made to the fixer who is out of line with the others.

A fixer who is careless in the care of his shuttle spindles and has too strong a pick on the looms will have the most waste every time. Where the weight of waste from every section is found to be far ahead of a reasonable amount, it shows at once that something is wrong with the filling, as no mill management can say that all their fixers and weavers

Every company has good men in its employ, so that the excessive waste must be put down to some other
are incompetent.
cause. Either the cops are spun too slack and spongy, or from poor stock, or the steaming may be at fault. Whatever the cause may be it should be found out and remedied. When we remember that the cop waste is only worth about one-third or a quarter of the value in good cops, to say nothing about the cost of collecting, bagging and shipping, it can easily be seen that the company is going to

LOSE SOME MONEY

where excessive waste is made. It is astonishing how many cops can be found on the floor underneath the looms in almost every weave room. These cops get oily and dirty, and are not fit to weave, and must be placed with the waste.

This always happens where the company tries to economize in the quantity of boxes and has the boxes filled to the top in the mule room. When a filled-up box is put on the stand at the loom, the vibrations of the loom will shake a few cops off the top of the box onto the floor. The best plan is to only fill the box to within about two inches of the top. The same thing happens when the boy who takes round the filling to the looms puts up a full box when the other box is not empty and puts one or two handfuls of cops on top of the new box of filling. No. 267.

CCLXVIII. SCARCITY OF WEAVERS.

There are a good many mills which are troubled at times to keep all their looms going. When the warm days come, the help begin to drop off the pay roll, either to have a long vacation or to take up work in some other industry, where there is more comfort or more money. However, as soon as the snow and frost appears, they flock back to the mills and try to get work again for the winter. They are willing to promise not to leave again when the next spring comes; but how many keep their promises?

As soon as the warm days come round again, they are ready to depart at the least approach of bad work. These kind of weavers are very

TROUBLESOME TO HANDLE

by the overseer and others. If anything should be said to them, it is the usual cry: "Well, if you don't like it, you can give me my bill." This applies mostly to the colder part of the States, where there is a large demand for help for outdoor work during the summer months, and the good pay assured during the rush, entices help from the mills. No matter how good the conditions are made in the mill, some will leave anyway.

The only thing which can be done is to try and reduce this wholesale leaving as much as possible by putting good material in the looms in the way of good yarns and styles which will weave well in the hot and dry atmosphere of the summer. The majority of mills are so stuffy and unhealthy that one can hardly blame the help for wanting to leave for awhile. When the weather is hot and unbearable, the only thing which can be done to make it more agreeable for the worker is to open the windows round the room, and if it is a windy day the looms nearest the windows are constantly stopped for yarn breakages, and much ill-feeling is caused among the weavers as to whether the windows shall be opened or not.

The overseer is continually

SETTLING DISPUTES

arising from opening of windows, and oftentimes loses some of his help. If the weave room was made cool and pleasant to work in by an installation of a few good fans to draw out the bad air, the fresh pure air would come in through the cracks and crevices round the room and would add very much to the comfort of those who spend ten or more hours in the weave room, year in and year out. A much more satisfactory way is to blow a good constant supply of cool, moist air into the room and force out the poor air. In this way humid atmosphere is always in the room and helps a good deal to make the warps weave better and keeps the room in a healthy condition. When the help is constantly leaving there is certainly a cause for it, and it ought to be the bounden duty of the company, as well as the superintendent and overseers, to find out what the cause is, and having discovered it, to do all in their power to remove it. It may mean the spending of a little money to make the work more comfortable and congenial, but it will always be found money well spent.

If all the machinery can be kept going the profits are more definite than if a goodly portion of it is stopped for three or four months every year. When the machinery is stopped the profits are being eaten up, because the production is less and the working expenses of the mill are going on just the same.

A weave room with plenty of daylight and good working conditions is the one which is

WELL SUPPLIED WITH WEAVERS

and few spare weavers waiting for looms. It is the dark dismal weave rooms which suffer most through shortage of weavers. There are a large number of weave rooms so immense that the daylight does not reach the middle of the room and artificial light must be used all the time. Not many weavers can be found who like to work under these conditions. They are constantly asking the overseer to move them nearer the windows, and if they are not moved they look elsewhere for work.

New weavers asking for work are invariably given looms in the middle of the room, because that is the place where looms are always "to let," but after working a few days they leave and go somewhere else. That is one of the reasons why we hear so much of the tramp weaver. The looms which are in a good position are soon picked up by those weavers wanting to move from a bad position, which is generally in a dark place. Through so many different weavers going onto these looms, the latter often get into a poor condition and the warps be-

come all crossed and twisted behind the lease rods, which makes it very hard for new weavers to keep the looms going, and after a few days they get downhearted and give up, unless the overseer can move them on to better work.

Some mills have

OVERCOME THIS DIFFICULTY

somewhat by choosing a few of the easy weaving styles to be put solely in the looms where difficulty is experienced in keeping weavers on them. This is the easiest and about the only thing which can be done to keep looms that are in a bad position supplied with weavers. A fixer who is incompetent at his work will often drive away the weavers. Often applications are received for work from weavers who state that if the looms were under a certain fixer they would not take them, but would look elsewhere for work. It is not often that we find a good steady fixer with a lot of looms stopped waiting for weavers, while we often find the incompetent fixer in this predicament.

No. 268.

CCLXIX. LIGHTING.

Before dealing with the efficiency of the workman and the machines in the weave room the writer is of the opinion that it would be well to consider the subject of lighting, as lighting has indirectly as well as directly a great influence upon the production. Although the modern mills are dealing more seriously with the question of light, there still exists a large number of mills that were built during the period of 1820-1840. These mills were so constructed as to have five or six floors in one building, with the weave room usually on the first or second floor. In that period the lighting, although considered quite a factor, was nothing compared to the systems that are being installed in our mills to-day.

We merely mention the above fact to show

THE RELATIVE COMPARISON

of the two systems, also to show the managers of the older mills, who find a difficulty in competing with the manufacturers who are working under more modern conditions, that this question is of vital importance, and one which cannot be overlooked. It must be dealt with to the extent that new weave sheds should be built if the older manufacturers wish to be in the race with their competitors. In these mills which have weave rooms on the ground floor it is quite essential, except on very bright days, to keep the lights going all the time, and, therefore, this is one of the reasons for the large overhead expense which exists in a mill of this type.

The next question to decide with regard to the lighting of weaving machinery is

THE PROPER LOCATION

of the light sources. It is a very important matter to have this location in such a position that the light will fall on the work in such a direction as to cast no shadows of the weaver on the machine. The installation of a good lighting system in the weave room not only increases the production but tends to make better weavers, and effectively reduces the percentage of seconds, which consequently means large returns for the amount invested. This may seem to be a broad statement, but if we look into the matter we find that it brings up the production for every hour of the day to that obtained under daylight conditions.

The arrangement of lighting in a good many mills

IS GENERALLY DETERMINED

by putting in the least light necessary, in order that the one who determines the location of the light may be able to see perfectly. This is entirely wrong, as the best light is always the cheapest. By that it is not meant that which gives the brightest light, as the light itself is but a small factor, and, consequently, must have a number of requirements before it is right.

First, it must furnish a sufficient amount of light to enable the operative to see properly.

Second, it must be placed in such a position that it will not cause the operatives any inconvenience, or, as stated before, cast shadows on the work. Take, for instance, an example such as a plain two-harness loom. You will find that if the source of light is not properly placed the arch of the loom will cast a shadow on the warp toward the front of the loom. If this shadow exists, it will mean that the reed is in total darkness, and, therefore, makes a difficult operation for the weaver to draw threads properly through the reed in the case of an end breaking. It is very readily understood that the

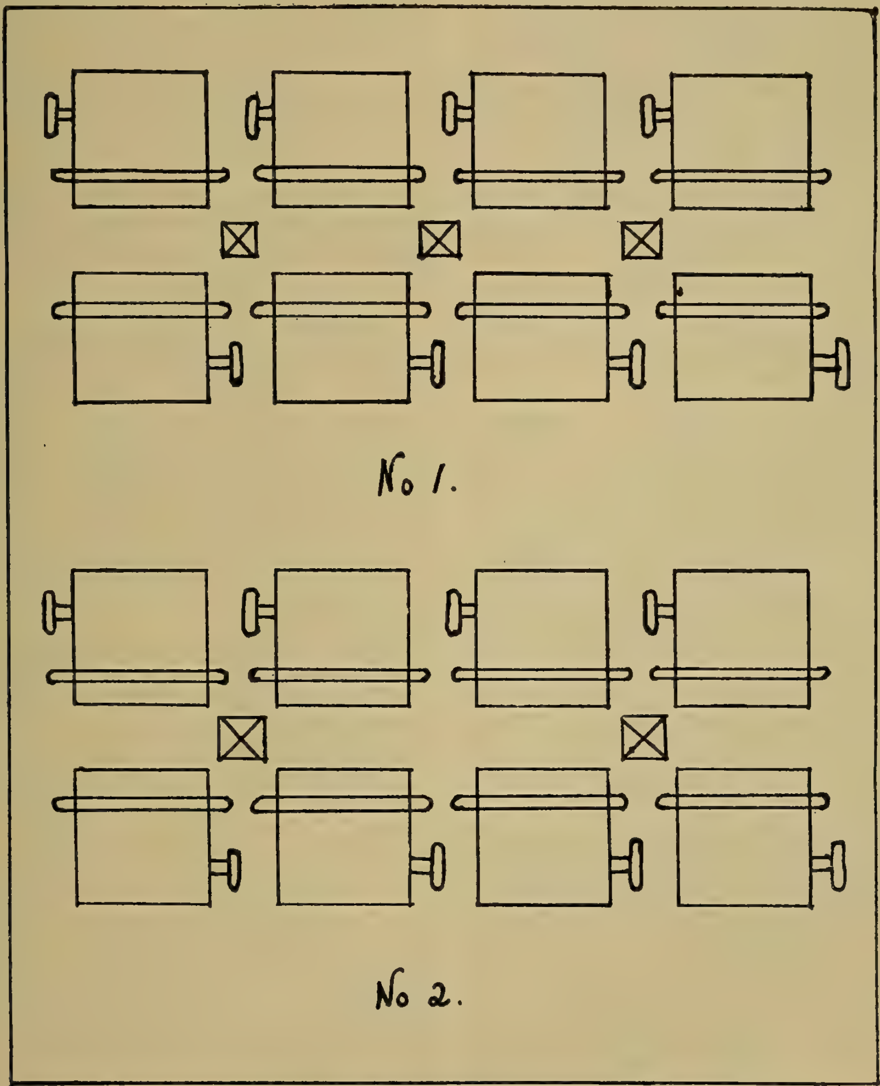


Fig. 127. Systems of Lighting.

production will be increased when a weaver is able to spot an imperfection or a broken thread at the moment it happens. To obtain this condition good lighting and proper placement is necessary, for every second that the loom is stopped or when the weaver is obliged to work in dark places actually means a lesser amount of production. Every moment saved in tying in a new thread will be saved many times over in the course of a day where a number of weavers are employed.

Third, it must be an exceptionally steady light.

Fourth, it must be protected so that it

WILL NOT SHINE

in either the eyes of the operative who is working on the looms over which the light is placed, or some of the other operatives.

The writer, having had considerable experience in large weave rooms where the weavers were required to operate quite a number of looms, noticed that the plants were equipped with what is termed "drop" lights, that is, one light over each loom. This is very objectionable, inasmuch as it takes up the weaver's time moving lamps about, adjusting cords, reflectors, etc., and also putting the weaver in his own light. Consequently, the best lighting conditions will reduce the percentage of time required for rest of overcoming fatigue, and, therefore,

THE DIFFERENCE BETWEEN

the cost of the best and the poorest lighting system is nothing in comparison with a saving of money due to decreased time for the rest period due to less tired eyes.

The system which the writer would advocate in order to have good lighting in the weave room would be to have the light sources placed in the weaver's alley in such a position that the greater part of the light may come in front of the loom. Then, again, they should be placed at such a height that the distribution will be equally divided, so that when the light from one lamp is blocked by the weaver's body not more than one-half the direct ray of light will be cut off. The economical advancement of wide spacing should control the decision in the matter, providing satisfactory lighting is not thereby hindered. Wide spacing results in the case of a small number of high candle power lamps, and when compared with a greater number of low candle power lamps, is, therefore,

MORE ECONOMICAL.

There is one objection in using a few large sources rather than a number of small ones. This objection can be eliminated, if necessary, by having a number of lamps bunched together as a cluster.

In conclusion, will say that as to exactly what lighting is most desirable, it is extremely difficult of solution, but that the fewer light sources used, compared with good illumination, is by far the most economical system that can be installed, and that the up-to-date mill managers to-day realize that the right kind of illumination means greater yardage, lower percentage of seconds and better satisfied operatives. No. 269.

CCLXX. REGARDING THE HELP.

Another greatly discussed problem which has confronted quite a number of the mill managers in the textile industry is the problem which embraces help, conditions, wages, etc. Of these, the most important to be taken into consideration is help. It has very often been said that we should have help that we can rely upon, also help that understand their different operations, as no weave room can run successfully without a sufficient amount of capable help. This is very true, that is, to a certain extent, but we must also take into consideration the fact that the greater per cent of the operatives in the textile industry today, particularly the cotton end of it, come from

THE MEDITERRANEAN SHORES,

which, we all know, have no great textile centres. Therefore, this ar-

ticle will not deal directly with the skilled help, but rather will point out to the managers how they may best direct the energies of the working forces to develop the highest efficiency of each individual operative, how to avoid mistakes and the personal interest to be exercised in handling the forces. One great fault with a good many overseers of the present time is the evident disregard which they have for the operatives' welfare, and their distasteful methods are very often the cause of mills losing excellent workmen.

There is no doubting the fact that it will pay any mill that may have an overseer of this calibre on their payroll to get rid of him at any price. He will do more harm in checking the ambitions and crippling the efforts of the operatives, not to mention the loss which may be caused by frequent changes and resignations, than he would be worth, even if he might possess the qualities of an ideal overseer. Another case of too much disregard which matured a rather extraordinary predicament came to the writer's attention from an overseer who was formerly connected with a large cotton mill in New Hampshire. For a considerable length of time the management of this mill had been rather careless and indifferent, and when the directors realized this state of affairs, they deemed it advisable to appoint a new man to take charge of the mill. In this particular case

IT WAS DECIDED

by one of the directors to give a relative the position of manager. This man was not well versed in the business, and made a practice of doing things in the opposite extreme, thinking that what was needed to make the mill go was "bits and spurs and a sound flogging." Inside of two weeks he had the entire mill on the verge of a revolution, simply because he started in (as a good many managers do) to either reduce the wages or try to attach more work to an operative than he was capable of handling. Then, again, he issued orders in regard to supplies that made it next to impossible to run the various rooms or to successfully upkeep the mill.

There is one essential in our minds that

MUST BE BROUGHT OUT

under all conditions to secure a maximum effort of any operative regardless of what kind of a man he may be, and that one essential is the capacity for hard work. Next in line we should put ability, and third, we reserve for integrity. If these three qualities are found to exist in an operative he is bound to be a great success, as only the first one is absolutely necessary. Very often we hear of men who have climbed the ladder of success by hard labor, men who possess neither ability nor integrity.

It would be a good idea for mill managers to look over their overseers, and for overseers to look over their operatives, with these three words in mind—hard work, ability, integrity—and handle their men so that they will work hard and act as if they possessed ability, for there is nothing like confidence and the good welfare of the men under their supervision. An employer must

SHOW HIS CONFIDENCE

in his employes in more ways than one, but there is one thing that he must always avoid, and that is over-confidence. A good stock of common sense mixed with the instinct to read a character will prevent a manager or an overseer from making fools of themselves and their operatives. An overseer who does not take time to hire his men properly and who does not possess the instinct to read character is bound to fool himself very often. In regard to this it is the writer's idea that it is entirely wrong to arrive at the point of a new man's capabilities by quick judgments, and the best way to employ a man is to draw him out. A little tactfulness is required to get a man to speak sincerely about his qualifications.

Another efficient system of hiring and promoting help is to take the smallest paid operative and gradually advance him as the opportunity presents itself. Another point to be considered when a man is promoted to a higher position is that the overseer must take it for granted that the man might possess a certain degree of shyness in finding himself suddenly subjected to the scrutiny of the managers and his former fellow employes. The overseer who forgets to make allowances for such a condition as this, and who insists upon results from the start is not in a position to see his men through on this promoting system.

THE PROPER KIND

of a manager or overseer is the one who is capable of outlining the operatives' work, getting them started on the right road, and continually coaching them until they have reached the standard of efficiency.

The subject of wages is far more disturbing to-day than it has been for at least the last ten years, as we have a more united band of labor organizations, such as the Industrial Workers of the World, the American Federation of Labor and the United Textile Workers. We have heard a mill manager of a large corporation say that no unreasonable demand had ever been made on him by a labor organization which he could not trace back to some act of injustice on the part of an overseer who lacked the proper executive ability. The average worker in the industry to-day, although requiring to a certain extent good conditions, etc., is more anxious and is willing to do almost anything providing the wages are tempting. It is about wages, directly or indirectly, that the majority of serious disputes arise. When the strike occurred a short time ago it was not for facilities that would promote decency, it was for more wages, more pay, and it is for this reason that wages rise up as the most important question in the industrial light. It is understood that the worker desires as high pay as he can enforce. The employer wants his production to be as cheap as his competitors, for if it is not he will be driven out of business. The operative cannot be expected to labor for his employer for less pay than he is paid under similar conditions for the same class of work by another manufacturer.

The subject of wages being so delicate and the wage scale so broad, we feel that to deal with it efficiently would require considerable time and space. No. 270.

CCLXXI. SANITATION.

It has been a recognized fact for a great many years that there are some mills being operated whose actual earning capacities are below par, but there are, also, other mills that have reached a very high standard of efficiency. This, however, goes to show that the true virtue of proper mill management is to obtain the greatest per cent of possible output under such economical conditions as to pay the corporation the largest margin of profit and still sufficiently allow for the proper upkeep of the plant. It is an

EXTREMELY BAD PRINCIPLE

and a false saving that is obtained by failing to upkeep the mill with supplies and the proper atmospheric conditions which surround the help. It is only the fair duty of all mill managers to keep their plants running in good order. By so doing they not only increase the dividends, but also keep the working conditions in such shape that considerable waste and bad work is eliminated.

A question of great economic importance in many of the older weave rooms to-day that should attract the attention of the mill managers and be given due consideration is the fact that good air and proper temperature and humidity

INCREASES THE EFFICIENCY

of the operatives to a great extent. The close connections between the conditions which surround the oper-

ative and his efficiency is a matter of common experience with us all. Take, for example, a very hot day in July, and a cool day in September. A good many of the operatives are kept at the July level all through the colder months. They work indifferently and not only accomplish half their labor, but destroy considerable of the material which is under their care. A remedy for this is not in the ordinary sense simply ventilation, but rather the conditioning of the air in such a way that the operative may work under the most favorable conditions. This is equally as chief an element to the industrial efficiency of a mill as it is to the

HEALTH AND HAPPINESS

of all its operatives. Yet, however, we often find that humidification has grown in the minds of some mill managers as merely a mechanical proposition; that is to say, in its relation to improving fibre conditions. This is very true, and has met with extremely good results, but this is only half the problem, as both humidification and ventilation must be considered as one. To secure the largest profits on a given expenditure and increase the production, it will pay the mill managers to give due consideration not only to the conditioning of the fibres, but to the health of their operatives, as part of this practical problem, for heat combined with excessive humidity is the one condition in the air that has, beyond a doubt, proved a universal cause of complaints, discomfort, illness and inefficiency.

Although the reduced output in various mills is due to the reduction of

WORKING FORCES

few people realize that the cost of sick and inefficient workmen is equally as great. We all understand that there is no profit in idle machinery, and that there are no dividends when this machinery is working poorly. Therefore, it is very apparent that the value of the operative is doubled when proper ventilation and humidification are installed.

Another point which may be brought out emphatically is to have a complete change of air in the weave room at intervals by producing strong drafts of fresh air. In mills having no air currents the hot, moist and stagnant air from the body clings around us in such a way as to make it extremely uncomfortable. It is quite important that a blast of fresh air should blow over the body at some time in order to produce an effect somewhat similar to the delightful sensation one receives when walking or riding against the wind.

In regard to cleanliness

IT CAN READILY BE SEEN

that if a room is not kept in an orderly condition the operative is likely to be as slack in his work as is the room itself, which will eventually result in an increased amount of seconds. If the floors are not kept in a sanitary condition they will become greasy, thus enlarging the chances for accidents caused by the workman slipping while walking back and forth at his work. The base of the wall should be painted with some color not trying to the eye, such as a dark shade of green. This will not show the dirt so readily as other colors. The walls from the windows up should be painted white, likewise the ceiling, as this will greatly add to the light by reflection. If the machinery is driven from overhead the shafting and hangers should be wiped well very often, for otherwise the oil and lint that collects will drop on the work and damage it. It is

A VERY COMMON OCCURRENCE

in mills selling their goods in the grey, that cloth has had to be classed as seconds, owing to oil or grease spots which have occurred in the middle of a cut.

Another matter which should be impressed on the operative's mind is that the machine should be kept well cleaned, as parts may become clogged with dirt or lint and thus result in the cause of another part breaking, and

unless the supply department is efficiently run so that the part can be readily obtained, it will eventually result in the stoppage of the loom. A very good plan that should be adopted is the enforcement of the weavers putting their cut into the rack as soon as it is taken off the loom and thus do away with oil and grease spots whicl

ARE BOUND TO RESULT

if the weaver insists on laying his roll on the floor or stacking it up against the wall, where it is liable to be brushed against oy some loom fixer's overalls, which are more or less dirty.

On fine work especially should this be adopted, as these fabrics are fairly soft and absorb oil and dirt very readily. Where it is possible it would not be an expensive plan to have adjustable covers made of some heavy material which could be fastened around a cut of cloth, thus affording protection. The weave room is sometimes located in a mill where dirt may fly in through the windows. The writer had occasion, a short time ago, to go through a mill where a weave room was situated very near the picker house of their own plant and a picker house of an adjoining plant. The windows were open and the dirt from

THE TWO PICKER HOUSES

was blowing in and covering the cloth which was being woven, and yet it was said that they wondered why so many seconds were being made. No. 271.

CCLXXII. ORGANIZATION.

We may well pause for a moment to consider some views of the way in which vast changes have taken place in this country in regard to the textile industry. It is a strange fact that until recently mill managers have not studied very deeply the labor situation in its broadest sense. There has been so much said and so much throwing down of the established order of things that the mill managers naturally begin to consider whether or not their rights have been taken away from them. The rule of the people has swept over the country to such an extent that

IT IS GENERALLY CLAIMED

that we need new methods, and a general overturning of old customs. In our estimation, it is simply history repeating itself, and if the socialistic reformers, who have so many remedies for old troubles, would study the conditions of olden times, compared with those of to-day, they would find that they were of a somewhat similar nature. We readily understand that this problem is a broad one, and that the manufacturers are beginning to realize more and more the great necessity of comprehending labor. Superintendents, overseers, etc., cannot hold their positions in mills unless they are capable of handling help, that is, to handle them efficiently. Yet the capability of handling help is only the starting point of the knowledge of labor.

Unless organization provides for comparing what is done with what should be done with the accuracy of mathematics a

HIGH STANDARD OF EFFICIENCY

cannot be maintained. It seems to be a very common occurrence in some mills to reach a high efficiency during a dull period of business, and to descend to a low standard during the period of increased activity, because the management has so little control over the details of the situation. What one employer might consider too small a production, another would deem a fair output. Therefore, it is to the interest of both employer and employe to mutually agree upon a fair time limit for each operation, so that both may know what he can readily expect from the other. Any agreement which holds an employe to a certain production as well as the employer to definite rates of wages and hours is really a safeguard to both the parties concerned. Having studied somewhat similar conditions, we have always found that to whatever

extent an employer was liberal in his treatment to the operatives that they would usually meet him half way. Consequently, an agreement

IS A PROTECTION

to the mill managers, not only as it places a limit on petty injustices on the part of overseers, second hands, etc., but also tends to prevent troubles from men widely scattered yet bound by the same agreement.

In a previous installment of this article we called the reader's attention to the unscrupulous dealings of some of the so-called shrewd mill officials, and this is a reason why trade unions try to add restrictions to their agreements as an effort to stop the abuses by these officials who are far too narrow to see anything but their own side of the situation. Yet, on the other hand, something must be said of the justification of mill officials who refuse to have any dealings with labor which is organized because of the unfair methods taken by some of its leaders, such as the firing speeches of the labor heads in the recent Lawrence strike, who cast down the

MORE CONSERVATIVE MOTTO,

"A fair wage for a fair day's work," and substituted "Acknowledge no flag but the red flag," a symbol of revolution and bloodshed. We have great sympathy with all the good operatives who are of the belief that our present industrial situation is far from being correct, and who contribute certain sums of money as fees, etc., to the work of making this country a better one, and we trust that they will not accuse the writer, who is mutual, of any prejudice for this point of view. We particularly refer to the seeming error into which they have fallen in regard to the unequal social conditions which exist in our form of government.

Now, the point that remains is simply this, that the sooner the mill officials can

GAIN THE CONFIDENCE

and create a feeling of contentment among the operatives, and contentment means the best paid operatives, they will at least have gained a point, and need not waste further efforts to do away with organized labor. Union men, like the majority of all other individuals, are first interested in their own behalf, and are concerned in their employer or their union only to the extent which they think each gives to their welfare. The one which impresses them as the most profitable will be the one which will receive their support and loyalty.

Then there are other organizations, termed the line and staff organizations, which are meeting with tremendous success in some of the up-to-date mills. Line organization is the training of the men in sequence of position, so that one may be able to fill his predecessor's place efficiently when called upon to do so, and its strength lies in its indestructibility. Staff organization is the

TRAINING OF THE OFFICIALS

in charge of the mill in such a manner that they may be capable to plan, direct and advise everything pertaining to the welfare of the employers in a very efficient way. It is very encouraging to know that some of the mills and a textile paper are establishing systems whereby employes who have worked in concerns a stated length of time are rewarded by pensions, profit sharing, gold canes and silver services. If this method, which they can easily afford, was adopted by all the mills, they would find little or no trouble in keeping more efficient workmen in their employ. The writer is of the opinion that we may take renewed courage and renewed strength with which to carry on our tasks with perfect confidence that they will be solved in due time as others have been in the past. No. 272.

CCLXXIII. TRAINING WEAVERS.

No matter where you go, or what mill you go into, you will always find good weavers, medium weavers and poor weavers, which we will call first class, second class and third class. If it was possible to have a

mill well stocked with all good first-class weavers, the profits would be much larger than they are at present. A first-class weaver not only turns off a big production, but the quality is generally good, for no matter what sort of work they get in the looms they seem to get through it, while the second and third-class weavers are constantly stuck and pestering the fixer because the warp won't weave itself, and then to finish up they go to the overseer with a pitiful story about having had the fixer at their looms about twenty times, and he won't fix them.

If the overseer goes to their looms and overhauls them he may find nothing wrong; it is only the education of the weaver that is at fault, or it may be that he is careless of his responsibilities as a weaver. The overseer who has under his charge a majority of his weavers of the third-class type is more to be pitied than blamed when his

PRODUCTION IS LOW,

as the anxiety and worry on his mind is so great that it ruins his health and he has to give up his position and take other work where the strain is not so great. We will just look into the situation as it appears to the writer. Almost all the mills in the country have had to rely on the immigrants from foreign countries to fill up their mills with the required amount of help. Most of these people have never seen a mill or machinery before in their lives, and it cannot be expected that all of them will turn out a success. Some of them would not make weavers in twenty years, while others pick it up very well, and after a time may be found among the second-class weavers, a few of them making first-class weavers.

We will, for a few minutes, look into the kind of training they get. They come to the mill door and ask, through an interpreter, if they can have a job in the mill; they have never worked in a mill, but they are anxious and willing to learn. The weaving overseer may take a few of them in hand and distribute them around the weave room with any of the good weavers who are willing to take them in hand and teach them the arts of weaving. This would be all right if they could stay with the weaver long enough to be able to run, say, two looms by themselves, and do all the work required and do it right.

LOOMS STOPPED.

Often the beginners are not to blame for being put on looms too soon. Take, for instance, a mill that has a number of looms stopped, and the superintendent, having this fact constantly brought before his notice will, on his round of inspection in the morning, ask the overseer, "What looms have you stopped this morning?" and the overseer might reply, "I have fifty looms stopped this morning." The superintendent will then put on a severe look of authority, and reply something after this style, "Well, you must get a move on and get some weavers, if they don't come after work, you must go after them and get all the looms going, or another man will have to take your place; why don't you put those apprentices on looms, and give some of the other weavers two more looms; do anything so that you get the looms going," and then walks off feeling a few inches taller, after having eased his feelings a little.

The overseer then shifts his help around, and places his beginners on looms, and thus gets all the looms going in another day or so, and then when the superintendent comes around the following morning and asks the usual question of, "How are you fixed for weavers this morning?" the overseer, with a feeling of pride, can reply. "I have all the looms going this morning." After a few days of "all looms running" the superintendent may start to talk to the overseer something after this strain, "Now that you have all the looms running, and a few spare weavers in the room, you had better start to weed a few of the bad weavers out and those who turn off a low

production, and tell them that they will either have to do better or leave, and let us see if we cannot get our production up a good deal higher."

PRACTICAL EXPERIENCE.

Some of our readers may think that such things do not happen, but we know, from practical experience that they do happen, and some of the overseers who read this paper can back us up. We have often heard it stated that in some of our large cotton manufacturing cities there are as many overseers who have gone back to fixing and weaving as there are overseers employed in the city. "Why is this?" you may ask. In the writer's opinion it is because too much is expected from the weaving department, in that all the faults and mistakes of the different processes in the spinning and sizing departments are brought to light in the weave room, and no matter what is wrong with the yarns or sizing, good cloth is wanted and plenty of it.

When a new overseer is taken on he generally brings along some fresh help, but when he has brought all the help he can, and cannot get any more, the company has no further use for him and before very long he is told that he is

NOT GIVING SATISFACTION

and must leave. A friend of the writer who was a second hand was spending his vacation a short time ago with some friends in another cotton city not a hundred miles from Boston, and asked at one large mill if there was a chance to get a job as overseer. He was told that there was not just then, but he could have a job as second hand, and if he could get about twenty or thirty English weavers in the mill he should have an overseer's job. He did not take the job and at the end of his vacation went back to his native town. This just goes to prove how much the overseer is valued. He is valuable only when he can bring along some good experienced weavers.

It is to be hoped that such cases as these are few and far between. What is really necessary to make good steady weavers are young persons just leaving school, giving them from six to twelve months' training with some good weavers before allowing them to have looms of their own. The younger the persons learn, the better weavers they will be in after years. Much has been said about the qualities of the Lancashire weavers; in the writer's opinion this is due to the early age at which beginners enter the mill. Until recent years a child could go to work in the cotton mills at the age of ten and work half time, that is, half a day, and go to school half a day, and at the age of 13 could leave the school altogether and work in the mill the full hours. By this means the child got three years' training with a good selected weaver at the wage of about 75 cents a week, and at the age of 13, was put on two looms. After the half time age was changed from ten years to the age of 12, the falling off in quality of the young weavers was quickly noticed by the managers and overseers, due, no doubt, to the shortening of the time in which the child got his or her training from three years to one year.

GIVEN TWO LOOMS.

At the age of thirteen the child was given two looms as formerly. If the half times are done away with and the age is raised when a child can leave school (and legislation is tending in that direction) then the Lancashire weavers will fall a little from the high quality mark that they have held for so many years, and come down more on a level with other nations.

One often hears it said that why the Lancaster weavers have attained so good a name, is because it is born in them. In the writer's opinion this is not quite correct, as families are constantly moving from the farming districts into the cotton towns where work can be found for the children, these children on entering the mills often turn ing out to be as good as the best

of them, even though their ancestors had never seen a mill. In our opinion the weavers who started mill life at an early age are the ones who stand by the mill and make it a paying concern, and not those who began mill life at an adult age, as these do not often give their minds to it as a profession, and are always on the lookout for some other trade outside the mill and ready to take anything that comes along, even if the wages are a little less than those earned in the mill. These are the sort of folks who give the overseer so much trouble by leaving in the spring and creeping back in October and November so as to be out of the cold during the winter months. If the companies would offer some inducement to the young people just leaving school to come into the mills, and pay them a wage while learning, they would get the benefit of it in after years by having a good class of help that can be relied upon to stay with the mill.

DISHONESTY IN WEAVE ROOM.

There are several tricks practiced by weavers, in order to put a little more money in their pockets. The writer may not know all of them but he will illustrate a few. One of the most practiced tricks is to take off the change or pick gear, and put on another one with one tooth more, and weave with this gear on for a few days, and then change it back again. It may not be found out when the cloth is weighed in the cloth room, and if it is thought to be a little light, and, on counting the picks, it is found to be slightly underpicked, the overseer or second hand may go and look at the loom, but he will find everything all right, and if he questions the weaver, well, the weaver will not know anything about it and cannot account for it.

Some weavers will put a count or two heavier filling in so as to keep the weight of the cloth

UP TO STANDARD.

By this trick the piece of cloth can be woven in less time, and although it is a little risky, it is like the farmer who waters his milk, or the grocer who sells oleomargarine for butter; if he gets caught and has to pay a fine, he can afford it, and it pays him to take the risk of being caught. Another way of tampering with the pick gears without changing a wheel is to put a small piece of leather into a tooth of the carrier wheel, and when the piece of leather comes round to the point in gear with the pick wheel, the carrier wheel will spring forward two teeth instead of one. The writer defies anyone to detect this trick by looking at the cloth, as the difference in the picks per inch is very slight, but what little there is, is in favor of the weaver.

A simple trick of this sort will put from 25 to 50 cents a week extra in the weaver's pocket. Everyone connected with the weave room knows how a weaver will cover over a patch of black oil in the cloth with chalk, and a scratch-up with soap or oatmeal and water. All these little tricks are done to get the cloth

THROUGH THE CLOTH ROOM

without the defects being seen, and so escape a call down or the imposing of a fine for bad cloth. Many times, when a weaver has put two shuttles in the loom at once and made a big warp smash, the writer has noticed that the dagger finger has been loosened and pushed in a little so that the tongue on the dagger rod would come over the frog without a shuttle being in the box. This is done so that they can have the warp redrawn at the company's expense, and also to escape being made the laughing stock of the other weavers, as it is great fun to the weavers when someone puts in two shuttles.

In mills where the weaving of cloth is paid for at so much per cut it is a common occurrence to have two or more rolls at the week end without a loom number, and after making inquiries of the weavers, as to whom they belong, no one can be found who will own them. On inspecting the cloth, it may be found to be so badly woven that it is not to be wondered at that it is without a loom number. Cuts without loom numbers are very frequent where

the weaving price is paid by the pick indicator, at so much per one thousand picks that the loom runs, instead of at so much per cut. If the cloth is bad, or, if there is a lot of mixed filling in it, the weaver finds it very easy to forget to put the loom number on the end of the roll.

Speaking of pick indicators, some of them are easily tampered with and are made to register more than the loom has run. Some can be taken off the loom very easily, and, by holding the indicator shaft in contact with the loom driving belt, a few thousand picks can be added to the indicator in two or three minutes, and the indicator can then be put back on the loom again. The writer has known cases where, when the warp was finished and the loom had to wait a few hours for another warp, the loom has been set running without shuttle, and the filling taken off so that the pick indicator would have a few thousand picks added. With the help of other weavers round about to keep a sharp lookout for "anybody coming" this fraud can go on for an indefinite period or until some one who does not get a chance to do it tells of the others. No. 273.

CCLXXIV. MILL YARD AND FACTORY TRANSPORTATION.

The electric vehicle as built to-day has a distinct field in which its success is admitted even by those who are skeptical of motor vehicle transportation as a general proposition.

One of the problems which confronts every agent, superintendent and yard master of a mill or factory is the proper, expeditious and economical handling of the raw material as it arrives, as it passes through the various processes until it becomes "finished goods," and then is delivered to the storehouse or to the freight house where the responsibility of distant delivery is turned over to the railroad or steamship line.

Not only are the

PROBLEMS OF TRANSPORTATION

encountered in handling the actual raw material, material in process, and the finished goods, but in many contingent parts of mill or factory work there also arise numerous calls for transportation of some character.

The lumber for the shipping boxes does not come in on wings, it requires hauling to the carpenter shop and from there as boxes to the finishing room or shipping department.

The barrels of dye and bleaching materials will not roll themselves to the storehouse, and from there to the dye works or bleachery; they must be teamed, and their weight is such that they make heavy loads.

Lumber must be moved to the various places

AROUND THE MILL YARD

where repairs are going on, or if construction work is in progress, bricks, lime, cement, crushed stone and gravel must be carted. These are only a few of the many problems in mill and factory transportation that confront the superintendent.

In some instances tracks and industrial cars have been installed in the endeavor to better yard transportation, but the work of almost any mill is of such a varied character that the network of tracks required to reasonably cover the routes desired, the cost of laying them, and keeping in repair, more than offset their apparent saving. And then again, it is often desirable to use the mill-yard vehicles around the town or city outside of the mill property on the public highways.

This cannot be done if industrial rail cars are used. Therefore, trackless transportation in and around mills is really what is required.

As vehicles operating around a trackless mill yard and town or city roads must be supplied with power, the nature of the motor is first to be considered. Electricity seems to be one of the most natural powers to be considered, not only on account of its cheapness, but because of its cleanliness, safety and flexibility. As the conditions are trackless, the vehicle used must be self-contained which means that its power, derived from the generator, must be accumulated in storage batteries; therefore we have given as the desirable method of transportation an electrically driven, storage battery truck.

In considering any method of transportation there are three things to examine: the road, the load and the vehicle. In trackless transportation the road must be accepted as it exists. In mill work the load must be accepted as it is received, and it must be delivered as ordered. These two factors of transportation are the same no matter what method is employed. Hills, bad roads, frequent stops and starts, long routes or heavy loads are equal in the demand made on animals or machines of any kind. The third factor, the vehicle, is the only one with which the solution of the transportation problem can be made any easier.

One-Ton Mill Yard Truck in Use by Pepperell Manufacturing Co., Biddeford, Me

THE ELECTRIC VEHICLE.

The electric vehicle for trucking and delivery is purely a mechanical proposition. It is a machine. Like other machines it can be built to do a given amount of work in a definite time at a certain cost under any known conditions. The safely carried load in pounds or tons is the basis of its mechanical design and construction. The specified speed with full load on hard level determines the amount of energy that must be stored in its battery at one time. This last condition fixes the size of the storage battery. The power and speed required determine the size of the motor and the gear ratios, while the total weight affects the tire design.

The cost of transportation by electric vehicles can be determined just as logically as the cost of operation of any other machine. It is merely a question of measuring the work and measuring the cost and placing one against the other.

Accurate engineering can be applied to the problems of transportation with greater satisfaction with electric vehicles than with any other type. Electric measuring instruments reveal, and record, if necessary, the condition and performance of storage batteries and electric motors. The cost of producing electricity is a known quantity. The amount of electricity necessary to charge a battery is measurable. The

amount of electricity delivered to an electric motor by the battery is a known quantity or can be measured. The performance of an electric motor is accurately specified for any conditions. Its efficiency is easily determined.

The work of moving a ton a mile per hour on a hard level road is expended in starting it from rest and in overcoming the resistence of the road, the tires, the bearings, the electrical circuits and the air. If the road is not hard or not level, of course, more work will be required to overcome its resistence, or to move the load up a grade. If it is necessary to start often from rest, more work must be done than for continuous motion.

A large saving in power is obtained by using the ball or roller bearings in motor, countershaft and wheels and efficient silent chains and roller chain drive between motor and wheels. Less energy is thus required, and a smaller and lighter battery may be used. The decrease in battery weight allows the framework to be lighter, reduces the dead weight, further reducing the energy consumption, the battery weight and the friction loss itself.

Another important improvement is the use of a single motor for driving the vehicle in place of two or four sometimes used in the past. The advantages lie in decreased weight, better motor efficiency, lighter batteries, fewer parts, simpler control and a reduction in energy required to move the vehicle.

A Portion of the Electric Garage of the Pacific Mills, Lawrence, Mass., Showing Five Trucks of Their Fleet of Eleven Electrics.

The motor requiring only a very small amount of current to carry the loads in level roads (from 25 amperes for the 1,000-pound capacity vehicle to 50 amperes in the large five-ton machine), is so constructed that it will withstand an overload of 100 to 300 per cent when heavy grades are en-

countered, as is often the case around mill yards and the surrounding country where the vehicle may have occasion to operate. The two and four motor trucks almost without exception require a larger amperage to operate than the guaranteed discharge rate of the largest battery which can consistently be installed in the truck. This results in a constant tearing down of the battery plates, making continual washing of the batteries necessary, and thereby rapidly shortening the life of the battery.

of the argument, and the corresponding items against the electric truck, including electric power at 4 cents per kilowatt hour, which is more than double the actual cost in most mills and factories; the actual economy in cost shows in favor of the electric truck by 22 to 53 per cent, according to the size and number of vehicles operated, and the surrounding conditions.

It should be recollected that the electric vehicle requires only the space it occupies. It needs no hay loft, stalls, harness room, bedding platform

Two-Ton Mill Yard Truck Climbing 12.4 Per Cent Grade at Amoskeag Mfg. Co., Manchester, N. H.

As most manufacturing companies are familiar with the horse-drawn proposition it is of interest to compare that method with the electric, therefore it may be stated that taking into consideration depreciation, interest, insurance, stable room, shoeing, veterinary charges, harnesses, blankets, stable-help and feed, on the horse side

or manure pit, nor does it require extra equipment to do twice the work that horses drawing the same capacity per load accomplish. While the stable man is obliged to keep a supply of extra horses to substitute for those which are sick, disabled, or being shod, it is not necessary to have an extra motor vehicle on hand, as 98 per cent of all

causes for delay can be provided for in advance and thus prevent or overcome loss of use.

In a small one-story garage, not over 25 by 50 feet, may be housed the complete equipment of five vehicles, which will displace and do the work of 9 or 10 trucks and 18 to 40 horses, according to the size of trucks and the method of working the horses. One intelligent mechanic and a helper can easily care for these machines and keep them in first-class operating order, while the drivers of the horses in a few days become proficient operators of the electric trucks. Notice the economy in stable room and help.

Two-Ton Electric Truck During the Snowy Weather at Pacific Mills, Lawrence, Mass.

While the heat of summer, the chilling rains in the fall, and the low temperature of winter, to say nothing of the glare icy pavements and deep snow, all work havoc with the health of the horse and make the death rate high, the electric truck knows no seasons, but keeps constantly at its work the year around, good and bad weather alike.

Accustomed as most horses are to moving freight trains and cars, it is nevertheless a fact that quite often a good horse will become frightened and run away, causing loss not only to vehicle, harness and load, but frequently irreparably injuring or killing itself or running mate. These incidents all go to make the horse expensive, and form links in the chain of strong arguments for the electric truck.

ELECTRIC TRUCKS.

Among the many arguments which should be considered by manufacturers in connection with electric motor vehicle work over horse-drawn trucks are, first, the cleanliness in the garage, and around yards, the vehicles and the motors driving them, running on very generously proportioned ball and roll-

er bearings, which are sealed, oil and dust tight and require oiling only once in six months, and, therefore, have not the dirt and hot oil throwing proclivities incidental to the gasoline machine; second, the electric method is cheaper, requiring a less number of vehicles, therefore less drivers, and the loading and unloading crews are less, or the present force is kept busier; third, while the electric current for the charging of the batteries is figured in all estimates on which this argument is based at four cents per kilowatt hour, it is a fact that most mills or factories can operate a small wheel or a small engine during the night, furnishing power to charge the batteries, or taking the current from the mill lighting plant before the peak of the load, utilizing power which would otherwise go to waste, thus reducing the cost of current to less than a small fraction of a cent per kilowatt hour; fourth, the flexibility in the handling, light or heavy loads carried with equal ease, the turning of vehicle and backing to freight cars, doors or elevators, and its ability, on account of occupying only 60 per cent of the road space used by the horse-drawn vehicle, flexible steering and starting and stopping devices, to travel in congested yards or buildings; fifth, it can be run into factory buildings, on elevators, into shipping rooms or freight houses, and on docks and wharves, all of which places are barred to the gasoline truck by insurance regulations; sixth, and most important, that the money invested in electric motor vehicle transportation will produce a larger dividend, when compared with present horse costs, than is earned in any other portion of the manufacture of textile goods.

ELECTRIC TRUCKING.

The facts advanced in the preceding paragraphs are amply justified by the experience of a number of well-known mills and factories of New England which have adopted the electric motor vehicle method. It is perhaps one of the strongest arguments in favor of the motor vehicle to say that all cotton and woolen mills, with one exception, which have made a primary installation of electric trucks, have, after a practical experience, ordered additional machines.

The illustrations which accompany this article give an exceedingly comprehensive idea of the appearance of the electric truck as used around the factory and mill yards.

The Pepperell Mills at Biddeford, Maine, have a number of electric trucks, which were installed five years ago in 1908. These have kept constantly at work, giving good results at far below horse vehicle costs.

At the Arlington Mills, Lawrence, Mass., three electric trucks, of one, three and five tons capacity are in use for general mill yard transportation.

A. G. Walton & Company, of Chelsea, Mass., use a three and one-half ton electric truck for hauling raw material to their works, and the finished goods to the freight terminals and store houses. This machine has been in constant use for nearly four years, and has been so satisfactory that in May, 1911, they purchased a second truck.

Simonds Manufacturing Company, of Port Chester, N. Y., use a five-ton electric machine for similar purposes.

One large mill corporation some few years ago installed a light, fast, covered electric vehicle which was used as a paymaster's wagon, and it was fitted for use in case of emergency as an ambulance for hurriedly conveying a sick or injured person to the hospital.

In another cotton manufacturing industry a five-ton electric vehicle was installed, working ten hours per day, taking the place of three horse-drawn trucks. Later, the enterprising engineer of this mill proposed purchasing an extra battery, putting on a night crew, and operating the truck 20 working hours per day. This has been done, and as a result the entire stable has been dispensed with, and the machine truck is now doing the work which before required seven horse-drawn trucks. No. 274.

CCLXXV. MILL PAINTING.

The problem of painting the interior of a new mill is especially difficult, by reason of the hard pine being often full of sap, and unseasoned. Oftentimes the construction is done in cold weather, and steam heat is not available until after the painting is begun. The effect of all this is to cause the sap to come through the paint during the process of seasoning, and to render it unsightly.

The best way to obviate these difficulties is, of course, to use well-seasoned lumber, and also to allow as much time as is possible after the construction of the mill, before painting at all. Conditions, however, oftentimes make this impossible, in which case great care should be used to buy paint from those who have made a special study of these problems.

Cold water paints often flake and scale from ceilings and injure the machinery and its products. Sometimes, however, cold water paint may safely be used on the walls.

"Lead and oil" is a safe paint to apply on ceilings, so far as any damage resulting from scalding is concerned, but it has an unfortunate tendency to turn yellow indoors, whether or not on well seasoned wood. This diminishes the light reflecting power of the ceiling coated with it.

To obviate

THE DIFFICULTIES

of both, a special mill white has been adopted in many modern mills, some as far back as ten years, and its use has been steadily growing. A reputable article of this kind, when applied over special priming coats, made to suit the special conditions of lumber, can be depended upon to give the best results possible to secure. The painting should be done, when not in dry summer weather with the windows open, after steam heat has been turned on, and ventilation allowed to take care of the condensation. It is important that the first coat penetrate the wood and remain, if possible, a week or two, in order that such sap as may come through from knots, etc., may then be touched up with shellac before a second coat of paint is applied. For best results a third coat should then follow, for considering the lumber conditions, three coats of paint are not too many to overcome them.

Some owners with large experience, and some mechanical engineers, where conditions are unusually unfavorable, apply but a single coat immediately following the construction, leaving until six months or a year hence further remaining coats. This costs more, because of the extra time required for painting after machinary has been installed and running, but undoubtedly gives the most successful results. Others paint all but the lower edge of the heavy beams, thus leaving an opportunity for seasoning to take place in them.

THE GREAT ADVANTAGES

of painting completely in time for operating the plant are that full benefits from the light reflecting power of mill white are secured, and a clean, sanitary looking plant results. The high gloss not only reflects the light, but sheds the dust, and, if necessary, can be washed. A well-painted mill will not require repainting for years to come, as the surface can be cleaned whenever it is desired to do so, and there is absolutely no danger of cracking and peeling if a mill white free from varnish is used.

Exterior painting is generally confined to the window frames, sashes, doors, etc., which are painted in dark colors, generally a standard color used by the mill for their entire property, fences, etc. Dark green may be well recommended for this purpose, also brownstone color. Three coats are necessary for best results, the first coat to be liberally thinned with turpentine. No. 275.

PART III.

The Cotton Manufacturers' Dyehouse

There are many preliminary considerations which concern the proprietor of a manufacturing plant and which he must settle in regard to the advisability of commencing a dyeing plant as an auxiliary to his concern, but these considerations are doubly important in the case of a newly-organized concern. A cotton dyeing and finishing plant is not so easily set up, and involves a more varied application, together with a greater complexity of preparing and finishing machinery than is usually the case with worsted or woolen goods. In districts isolated from the neighborhood of the textile industries, there is frequently no other option than to run a complete plant, from the buying of the raw stock to the completion of the finished article ready for market. In such an event, the management has no other alternative than that of choosing a good site for the dyehouse, seeing the same built, and equipping it with economy and good management. Adversely, the cotton manufacturer surrounded by public dyehouses has quite another aspect for consideration. He has to place before himself an exact estimate of his proposed dyeing costs as compared with the cost of dyeing in the public dyehouse. In many cases, the public dyer will be found to have the balance of cheapness and safety in his favor. In the case of a new concern, it might be said to be especially so, since dyehouse defects, being usually difficult of explanation, it follows that, in a new dyehouse and new plant, the greatest trouble would be engendered. Hence, where a public dyehouse is at hand, it is expedient that the dyeing be done by them until a standard article, known to dye well, has been produced in the new concern, the eventual installation of such a plant depending solely on the price paid for public dyeing as compared with the estimated cost of installing and running such a plant on a reasonable margin of profit. In a mill district, it would be possible to duplicate in a large degree the advantages found in any other concern in the neighborhood, the risks being in this case reduced to a minimum. On the other hand, a country concern is handicapped by the never ending disadvantage of isolation from the labor market. The want of a competent dyer and dyehouse laborers has been the undoing of more than one manufacturing concern.

LOCATING THE DYEHOUSE.

Having settled upon the necessity or advisability of running a dyeing and finishing plant, the materials at one's disposal must come in for a more specific consideration. Here the good planning and forethought of the mill construction expert will evidence itself, for had a dyehouse been the ultimate idea of the owners in a future enlargement, a suitable location would have been left in such a position that the dyehouse, when complete, would form a compact entity fitting into the harmonious working system of the mill. Dyehouses, for lack of a little initial forethought, are too often placed in some odd corner of the premises, the owners not having contemplated the possibility at the outset of ever being sufficiently extensive to be able to run a dyehouse. Such dyehouses, in addition to being inconvenient, become an eyesore to competent workmen and the bane of the dyer's existence, he being probably greatly troubled by a strong southern light.

It is essential that the dyeing and finishing rooms be adjoining each other, so that the dyehouse never becomes congested with material waiting for transit. They also should be placed in such a way that conveyance from weaving shed to preparing, preparing to dyeing and dyeing to finishing is ac-

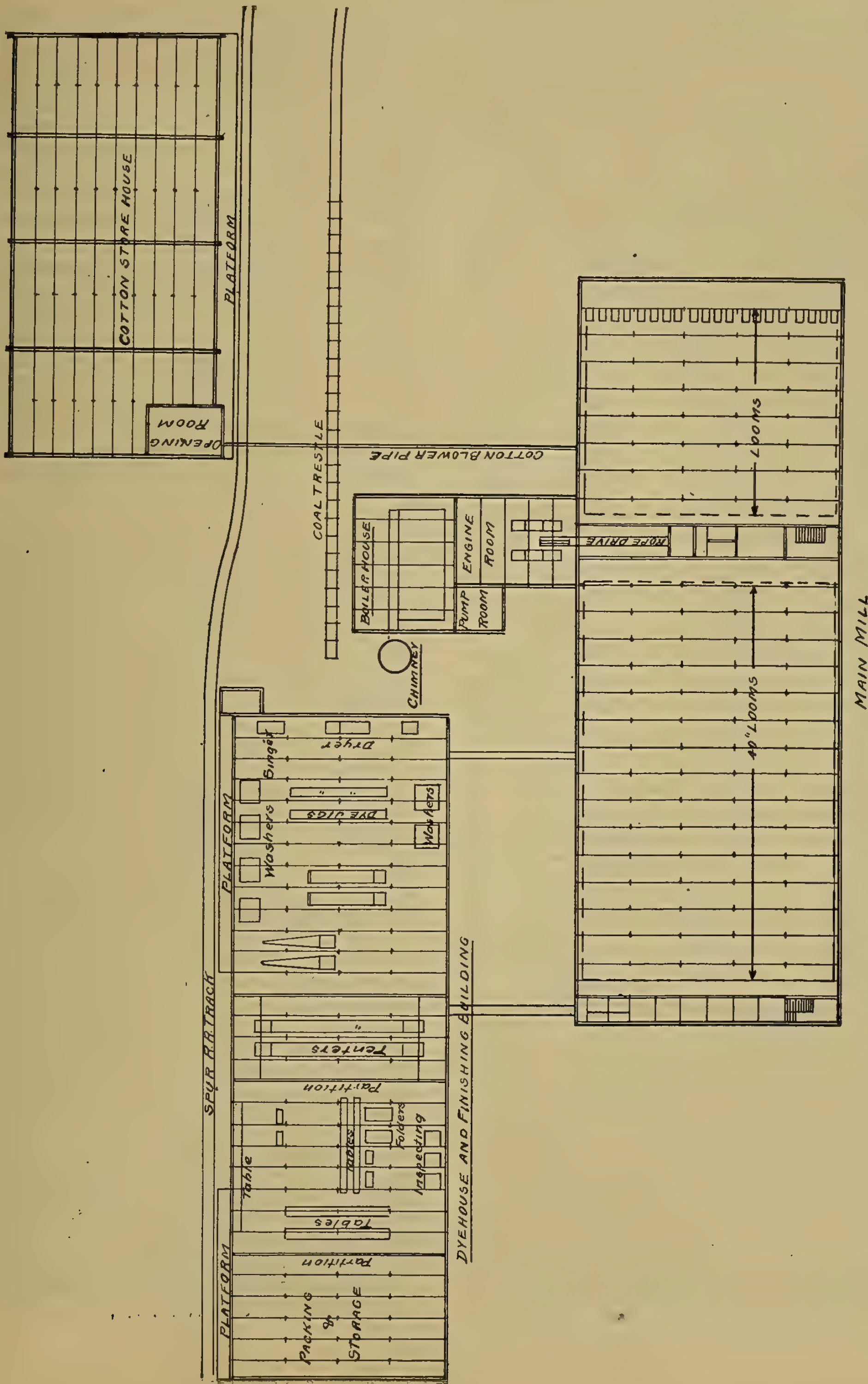


Fig. 1. A Typical Mill Layout With Dyehouse.

complished with the least possible trouble. The weak points in a mill outlay and system are often found in this disjointed connection between the dyeing and finishing and other departments; and in the finishing, sometimes with isolation of one part here and another there of the finishing machinery. The location of a dyehouse cannot be too carefully considered, as the difficulty otherwise encountered in handling the goods entails a lack of efficiency leading to an increase in the cost of production.

Figure 1 is a first floor plan view of a typical cotton mill operating its own dyeing and finishing plant. The drawing from which Figure 1 has been taken was made from the American Wool and Cotton Reporter by Lockwood Greene & Company, mill engineers, of Boston.

THE BUILDING MATERIAL.

Considering the building construction of a dyehouse, some suggestions might be made. The advisability of erecting a corrugated iron structure will depend partly on the insurance companies, and partly on the difference in price between a stone, brick, or corrugated with wood or steel framework. It is advantageous to have corrugated iron for the dyehouse where a possible extension is contemplated, and where looked after with paint it may be a long-lasting structure. A No. 24 corrugated iron is generally used, and the metal often replaces the wood framework where the insurance is at all likely to be exorbitant. In this country the dyehouse of corrugated iron is popular, and even if not kept in repair, the atmospheric influence is not of great account in a place usually submerged in wet and dampness. Wooden floors are more the rule than the exception; on the contrary, the English custom is opposite, they preferring the stone floor in which the flags can be well swilled and the goods laid out on them, often a great convenience to the dyer.

A bad water invariably means bad dyeing. Permanent and temporary hardness will both cause a precipitation of lime salt on the goods, thus causing streaks; the temporary often by a direct precipitation, while the permanent hardness is capable of precipitating the dyeware in such a way as to cause streaks of a similar nature. A water softener is in these cases essential, since the greatest evil possible in a dyehouse is to have a bad and impure water supply. Having the dyehouse in the vicinity of the boiler-house, or at any rate in such a position that dry steam is obtained, forms a factor contributing to dyehouse efficiency, since the boiler-house and dyehouse at a considerable distance from each other will mean the dyer using steam carrying with it large quantities of half condensed water, a bad feature in cotton dyeing where the concentration of liquor bears a far more essential part than is the case in wool or silk dyeing.

THE NEED OF A NORTH LIGHT.

The essential position of having a north light cannot be too strongly emphasized. A good dyer is not apt to allow his eyes to be strained by a south light for any very long period, this question of a good northerly light for the matching-off room having become an important factor in the keeping of a good dyer. Better matching is another result; and the dyer having his office nicely fitted up and in a location satisfactory to himself is likely to become a permanent man and as such, a profitable one. A good high roof is a desirable, but not always an obtainable, asset, having an ample outlet for steam in the roof. If this is not provided for the inmates suffer from the heat rather severely in summer and from a lack of air in winter and are placed at a disadvantage by being unable to see on account of the steam. The height of a dyehouse, although not essential to its efficiency, still constitutes a very desirable element to its appearance and comfort. Goods left lying for any time in such a place are possibly much less liable to suffer from milldew than is the case with those goods left standing in a low-roofed, congested place.

Having made these few remarks on the building construction, probably

more from the dyer's point of view than any other, we might now consider the fitting of water and steam pipes as the next in sequence. The ordinary wrought-iron piping is well enough adapted for both these purposes. A good flow of water is essential in the dyehouse, it being well to remember that any error made in the fitting of water pipes in this department should be an error on the side of too large, rather than too small a water capacity, as anyone conversant with dyehouse work alone knows the inconvenience and waste of time engendered by a deficient supply of water. With regard to the use of steam, a similar precaution might apply, although not in so marked a degree, the danger, on the contrary, being of heating the dyeings up too quickly. When once on the boil, half a round of steam is usually sufficient to keep at the boil. In the regulation of steam pressure it is an advantageous thing for all dyehouses, whether wool or cotton, to have a pressure of not more than 65 pounds since direct steam at a higher pressure delivered into a dyeing machine of whatever character is likely to prove dangerous to the men working on that macnine. The steam joints are also likely to give trouble,

Steam joints bursting are a menace to the dyeings if these should, as is usually the case, depend on a steady boil given for a specified time. Steam pipes must be encased in the usual composition if steam is to be economized and obtained in a good state for the cisterns. There are many firms which do this encasing. An inner layer of composition is first put round the pipe, to be afterwards further encased in a similar substance made in roll form, and made to fit round the pipe in a layer, the whole being then metallic hoop-bound. For smaller steam pipes, only the first composition is necessary, this being well tarred with pitch, or perhaps painted, thus securing a more stable and less crumbly protector. If only a small work of this kind is to be done, a composition made out of brown clay and horse manure, too-thirds of the former to one-third of the latter, thickened round the pipe, allowed to dry, and well tarred over with gas works pitch, will be found to be satisfactory.

THE DYEING MACHINERY.

We now come to the arrangement of dyeing machinery which entails some specific knowledge of the class of materials to be dyed, since the fastness, the method of treatment and the kind of machinery required to produce any particular dye or any particular kind of fabric, must be known.

Speaking generally, the jigger is the machine of most general application in cotton dyeing, it being to cotton dyeing what the cistern is to the wool dyehouse. The jigger is simply a rectangular box, five to six feet long, varying in depth from 18 inches to 3 feet, and three feet wide at the top with sloping sides down to two feet. The inside is fitted with five rollers, three top, two bottom, while above the box are two large beam rollers on which the material is wrapped, and passed from one to the other at each side of the box. In this passage the goods go into the liquor over the five rollers, and in doing so, obtain two separate immersions of dye-liquor in the cistern. The motive power is supplied by a shaft running at one end of the jig working onto a worm screw, which acts as the reversing medium for transferring the power from one beam roller to the other. In this way a number of "ends" are given to the material, six being the usual number for a first finish direct color dyeing, while eight are requisite in producing a direct black. This machine is used for all classes of heavy or light-weight materials, mercerized, bleached or unbleached and in many dyehouses, constitutes the one and only type of machine, and serves for all classes of fancy colors, finding its only restriction over a wide field of dyewares in its inability to dye indigo piece goods.

CONTINUOUS DYEING MACHINE.

The next two machines of most general use, are the padding and continuous dyeing machines. For most pri-

vate concerns, a continuous dyeing machine may be said to be somewhat of a luxury, it but supplementing the jigger, doing the same work, but having an increased production. In the dyeing of mordanted, tanned and other two or more bath combinations, this machine serves an especially useful purpose, which, had the same work to be done by the jig, would take a combination of two or three machines entailing a lengthy transference of goods from one machine to the other.

The continuous dyeing machine consists of a number of compartments, fitted with guide rollers at top and bottom, around which the cloth is made to pass, thus receiving a number of upward and downward movements through the liquor. Between each of these compartments is a pair of squeezing rollers, squeezing all the dye-liquor out of the fabric, thus, after each squeeze, the cloth is made to absorb the dye like a sponge. As remarked, the great utility of this machine becomes evident where a number of successive processes are involved in it, thus being a saver of time and dyeing material. A tannin shade is, for instance, run through the first box containing the tannin material. In the second, it receives the fixing solution for the tannin matter, while the third washes, and the fourth, and perhaps fifth, make the dyeing, and the sixth makes the final washing or maybe a further fixing solution. Thus, the whole of this operation, which would entail much time and waste in the making of clean liquors if done on the jig, is here completed in a few minutes. Should there be standard shades of navy, blacks or any other color in any daily quantity, it is indispensable to have one of the machines, but in the small dyehouse, although very useful, it will not always be found to pay an installation.

THE PADDING MACHINE.

In the padding machine we have something essential to the dyeing of light shades and many other shades which require an application at a low temperature. The fibre, not getting the usual boil to help penetration, a system is adopted whereby the penetration is facilitated by a hard squeezing of the goods through two or three heavy metallic rollers. Cotton dyeing being, to a large extent, a mechanical penetration of the fibre, this squeezing process brings about the end obtained by subjecting the goods to a high temperature. A pad once in the dyehouse, its utility is unlimited, the dyer finding it especially useful in touching up previous dyeings found to be a little off shade; when once run through the pad will accomplish a result, which, if attempted in the jig, might mean a complete re-dyeing. Padding is often done cold. In using the machine, the cloth passes through a liquor containing the dyestuff. After a passage at full width, the goods receive a hard squeeze between wrapped metallic rollers and out onto a beam roller at the opposite side. It is more general to find the double padding machine in operation, the only difference being the addition of a third roller placed above the other two, and a small roller at the bottom of the box. In this way, two passages of the fabric through the liquor are given in the same operation; likewise, one passage only may be given, just as desired.

These three machines generally cover the whole curriculum in the dyeing of plain cotton piece goods. If the plant desires to take in cotton hanks, warps, or stock for the making of fancy goods, we require another class of equipment for our dyehouse, but, generally speaking, of a less expensive character. The continuous piece-dyeing machine may be used for the warp dyeing and is ordinarily the most satisfactory machine for this purpose, providing slight modifications be made suiting the character of the warps.

DYEING RAW STOCK.

Machinery can be, but is not generally used in the dyeing of raw stock. The requirements for this purpose are a large cistern, cylinder shaped, with flat bottom perforated with holes, below which is fitted the steam pipe. The liquor being in the cistern, the cotton is entered and turned by a man with

a large pole. For yarn, a cistern is constructed 11 feet in length, 3 feet, 6 inches wide and 4 feet deep, with or without false bottom at choice, a steam pipe being fitted along the bottom. The yarn, whether bleached, mercerized, or unbleached, is placed upon sticks running between the centre of each hank; on these the yarn is entered into the cistern. One-third of the yarn being out of the liquor, a workman "broitches" the yarn, which is turning the yarn from end to end with a smaller stick thus ensuring both ends dyeing equally. About twenty-four sticks with yarn compose one cistern and a space of three feet cient room to spread out the raw cotton before entering the cistern within easy access of barrows to the side of the tubs. A slight modification is required in the dyeing of sulphur colors on yarn. An iron piping bent in such a way as to completely immerse the yarn in the liquor instead of leaving the one-third exposed to the air is used. The ends of the piping rest on the edge of the cistern as before and each stick is raised when turning of the yarn is necessary. This prevents oxidation of the sulphur coloring matter, being an inexpensive accessory.

We have now roughly considered

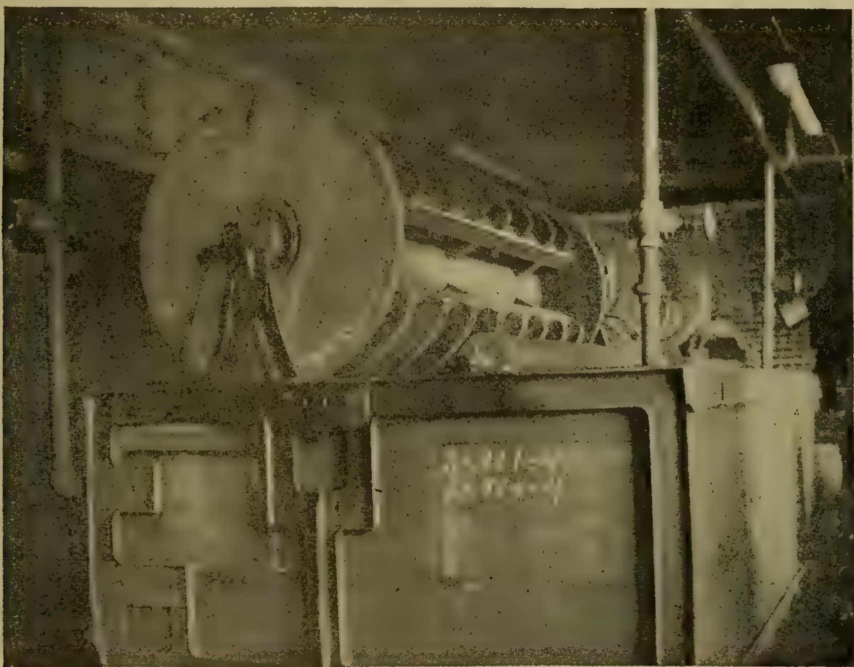


Fig. 4. Dyeing Machines in a New England Mill.

is available in which the goods are moved about in the liquor to ensure level dyeing. Yarn and stock dyeing cisterns may be placed in any position of convenience in the dyehouse, the only provision being room enough to place a framework on which to rest the yarn sticks when going into and coming out of the cistern, also suffi-

the methods of dyeing, and the four possible forms in which cotton may be brought to the dyer. A few remarks as to the general arrangement of the dyehouse will here be apportune. The jig dyeing is always found to be at the greatest point of vantage for general convenience if the jigs are placed at right angles and close up to the

dyehouse wall, the long working shaft, common to them all, running at a distance of six inches from the wall. At this end of the machine, it is most convenient to have the water and steam enter, while just above may run the main steam and water pipes supplying them and branching off at angles to supply the different machinery extended over the floor space. The padding machine is also usually favored with a place near the wall at some point furthest away from the dye wareroom where no dyestuff is likely to settle. Goods for the padding machine, besides being those for light shades, are often the ones which must be left lying in the dyehouse to be done at odd moments, another reason for its being in some unobstructive corner. By this arrangement, a good open space is left in the middle of the dyehouse for "cuttling," storing and standing of barrows. It is a good thing if the dyestuffs can have a separate room by themselves, though one partitioned off answers the purpose of keeping the dyehouse free from all the dust of the drug room.

WHAT OTHER MACHINERY.

It depends on the spaciousness of the dyehouse as to what machinery other than pure dyeing machinery may be placed in the room. Crabbing machines for worsted and cotton are usually found in the dyehouse and more often than not the washing machine for all cotton goods. A washing machine is a great saving of time compared to washing on the jig. It consists of a small tank fitted with a succession of upper and lower rollers, over which the cloth passes while being subjected to a constant flow of clean water. After this passage, the goods are well squeezed by three rollers placed vertical to each other, being then ready for sizing or passing straight on to the dyeing cans. The pieces are on a beam both on entering and leaving the washer and pass through the machine at full width just as wound off the jig.

In the dyeing of fine Italians and linings, it is often done in a cistern similar to that used in wool dyeing, fitted with ordinary winch and worked in an exactly similar way to unions or fine cashmere goods. This is a cheap way of dyeing these materials in quantity and where Italians and linings are principally dyed a direct black, it is advisable to pursue this course, bringing into the dyehouse a winch dyeing machine, especially constructed for this purpose. For most Italians, a crabbing and steaming is required before dyeing in a similar way to worsted. This is to set the material, preventing all possibility of crimping in these finely woven goods, besides giving to them a rather finer surface in the finished piece.

SINGEING AND SHEARING.

When the goods come from the weave room, the preparatory process is that of singeing. If shears are a part of the equipment, then singeing is left out, being replaced by shearing after the goods have been dyed. The more general course for cotton goods demands the singe. Singeing is the reremoval of all superfluous hairs from the surface of the cloth, being as much applied to cotton as shearing is to woolens and worsteds. Shearing for cotton is generally for economy sake, in places where union and worsted goods demand the shear and cottons are not sufficient to warrant the installment of a singe.

The two kinds of singeing, gas or plate, are used according to the kind of fabric. Linings, Italians, duck and all plain weaves go for plate singeing. Corduroys and all heavy goods with raised surface, having any kind of raised design, invariably go for gas singeing. Of the many kinds of gas singes in vogue, their chief claims to superiority lay in the economy of gas. The most excellent type is that in which the Bunsen burners are brought twice into contact with the cloth, once over the side of the flame, the fabric being arranged to pass the flame in this manner by a system of rollers, two treatments being given to the one passage.

Plate singeing is probably the cheaper method, equally so the best, where the kind of material permits. The

pieces, having been carefully beamed, are, on entering the machine, passed over a first roller and three stays, effecting a perfect straightening of the goods. A rapid passage is made over the white hot singe plate by means of a donkey engine supplying power to the receiving roller for the goods at the back of the machine. The process being reversed, the goods are drawn over the plate in an opposite direction by a reversal of the power from the back to the front of the machine. The face side usually passes twice, while the back of the piece is sufficiently well singed by one passage.

THE BLEACHING MACHINERY.

The goods having left the singe plate are ready for bleaching. To run a bleach-house successfully, there must be a plant well equipped with machinery in every particular and under the control of a competent bleacher. There are a large number of manufacturing concerns doing their own dyeing are quite content to have their bleached white goods sent out to some bleach-house. The dyer himself is able to produce a caustic bleach on his jig, commonly known as the old Turkey red bleach, which will meet the demands of any light shades he may have to dye. The goods are taken in the afternoon, placed on the jig and subjected to a boil in clean water, being afterwards allowed to stand over night. In the morning they are run through a boiling caustic

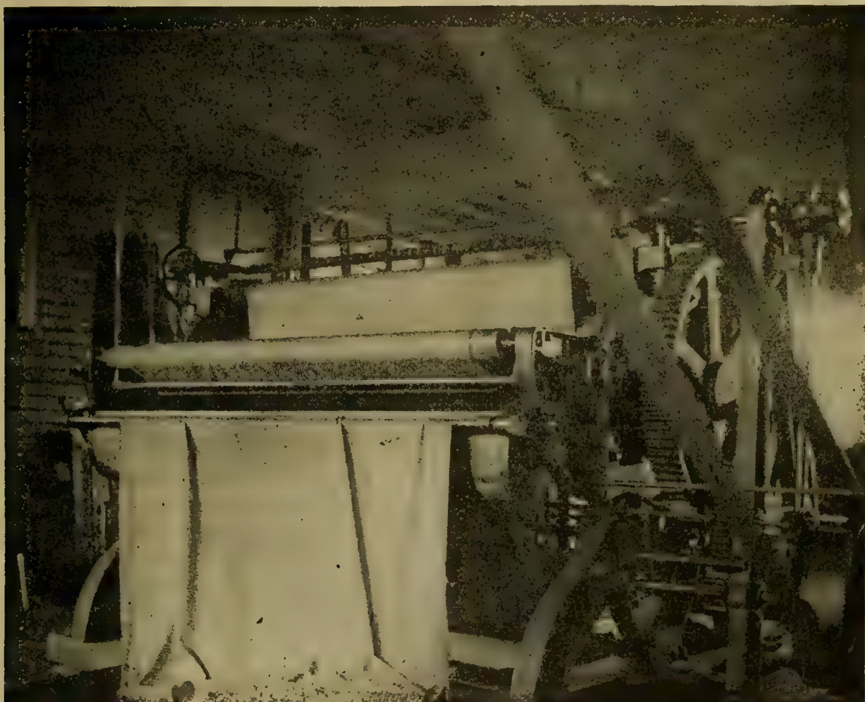


Fig. 5. Finishing and Pressing Machine.

bath of about 6 per cent Twaddle for one or two hours on the jig, according to the nature of the goods which may have to be treated to a second bath of boiling caustic before being sufficiently white for some particular requirement. Having obtained this result the goods are washed and given a weak solution of sulphuric or hydrochloric acid until

no further trace of caustic is present in the water, which may be tested by litmus.

Thus, for a small manufacturing concern for piece goods, the absolute essentials in dyeing and finishing machinery are singer (or shear), washer (may be done in jig), stiffener, drying cans and some kind of a press or calender for imparting a final gloss or finish to the goods. The higher the quality of the goods manufactured, the more these machines will be supplemented by other machinery, but these alone are necessary for a plain quality of cottons. Bleaching is an industry in itself, while mercerization, mercerized goods, Schreiner and silk finish naturally require a complexity of machinery.

THE STIFFENER.

Singer and washer having been described, the stiffener is next considered. This consists in a jig shaped box fitted with one central metallic roller of fine polish, usually brass, and at the bottom of the box are two small running rollers. At each side of the upper part of the large central roller are blades running the whole length, which are connected to levers having weights so that pressure can be put upon them. These blades, at one side, keep the stiffening matter from adhering to the roller, while on the other side the cloth passing between it and the cylinder roller receives a hard scrape, thus going away from the machine with an equal surface of adhesive stiffening substance. The goods entering the machine without any creasing pass underneath the first blade into the stiffener and are given a passage by means of the two small rollers at the bottom of the cistern. Passing up, the goods impregnated with stiffening go between the large polished roller and the perfectly true edge of the blade, here being scraped to have a level coating of the stiffener. If the blade is not perfectly true, a thicker layer will be left on some places than on others; this will show up in the finished piece and may often be detected when the cloth leaves the dry cans. The pressure put upon this latter blade affects the amount of stiffening required on the fabric and must be regulated according to the strength of the goods. Fabrics are always passed through this machine with the face side onto the cylinder; especially is this so with print goods, the face side not being directly subjected to the scrape.

OPINIONS ABOUT SIZING.

For most ordinary woven goods, only a light size is necessary and in the event of a small mill endeavoring to curtail machinery, an ordinary dyehouse padding machine is found to answer the purpose equally as well. The padding machine however, is not used for a size of over 30 per cent. Sizing both lays and strengthens the threads; it is often carried out to the extent of 150 per cent on the weight of the goods which serves no other end than that of making a cheap fabric. Hygienically speaking, it is bad, and from the wearing point of view, equally so. Metallic salts are used in heavy weighting or stiffening, causing injury to the fibre. A light stiffening is necessary for a good finish, besides improving the strength of the goods, but a heavy treatment is to be discouraged in every respect.

THE DRYING CANS.

After stiffening, the goods are ready for the drying cans. A drying can essentially consists of a number of tin cylinders eighteen inches in diameter, sometimes placed in a vertical double row running from a lower to an upper story or in a horizontal position to the floor. A passage of steam through the hollow centres of the cans, commencing with that on which the piece first enters the machine, this consequently, being the hottest. The pieces entering the machine are straightened and pass onto a lower can, next onto a can on the upper row and alternately until the end of the machine is reached. A pressure of 5 pounds is sufficient in the cans for all practical drying purposes. The back side of the piece is that coming into direct contact with the metallic surface of the dryer. A small one-cylinder engine at the side of the machine usually furnishes the motive power

for the dryer. This machine is not one entailing a large expenditure of capital, an average price for a 12-can dryer being, say, $500. It is often well placed on the vertical plan against the wall of the finishing room. The pieces being run onto the dyer and the top can being above the level of the second floor, they may be taken off just at hand for rolling, pressing, or making up. Print goods, of course, require only contact with the back side of the piece and cylinder. A special method of running the pieces over the dryer is wanted, but ordinary cottons may have both faces exposed to the cylinder.

ADDITIONAL PROCESSES.

After drying, a number of processes present themselves, and a general process entailing a minimum of cost and machinery is almost impossible. Ordinary plain weave cotton fabrics are largely sent to market by the manufacturer in the "brown" state, or in a condition which has required the smallest amount of expenditure in making a presentable appearance. Here is involved the brush, possibly the tenter, the steamer, calender, roller and measurer. Stretching is a process done at different times in the finishing, either immediately after drying or after calendering. It is not essential, although an advantage, and especially for stiffened goods, it is known to impart a clothy feeling. Apart from this, the stretching machine's chief object is to bring the goods to their normal width, a slight contraction having taken place during the previous processes. This contraction is not considerable, it really being due to a large number of minute creases or curls in the filling. Where a good opener is placed at the front of the can dryer, these creases are, in a large measure, taken out, and the piece enters the machine in a stretched condition and is so dried that a further passage over a tenter or stretcher is obviated, unless a special process for highly stiffened goods is required.

THE BRUSHING MACHINE.

The brushing machine often used in conjunction with shears is capable of removing all motes, specks and so forth, and making a smooth surface previous to the final calendering. Where singeing takes place before dyeing, the emery rolls and beaters of the machine are not required, but a good brush is advantageous.

The machine roughly consists of four adaptations: the emery rolls for medium and heavy classes of goods; the beaters, being cylinders fitted with steel blades having sharp edges which remove little knots and lumps; the brushes, of Russian stiff bristles or soft bristles, as required, which brush off all loose particles adhering to the cloth, and the card rolls, another device for removing specks and lumps made of steel fillet with straight teeth.

These four sections of the machine are all moderated or left out, according to the nature of the cloth. In case the goods have not been singed, the shearing here follows, but as remarked before, the singeing whether plate or gas, is a saving over the shear, where either process may be resorted to. Generally speaking, they may be substituted for each other, either on sheetings, drills, shirting, ducks, or any plain-faced fabrics. On the other hand, a gas range always shows up to advantage on raised designs.

IMPERFECTIONS IN FABRICS.

Having passed through the brushing process, the goods are next ready for damping and calendering. The importance of damping cannot be overestimated. An insufficient damp means that the pieces will become hard and in the calender not receive the benefit of the roller pressure to impart a good finish.

On the other hand, if the goods are too much dampened, they will finish up soft and flabby, without body, and are especially subject to mildew, resulting in eventual claims on the manufacturer. Water is thrown against the cloth. in a very fine spray with sufficient force to penetrate into the centre of the structure, and in such a way that a uniform surface of moisture is given

to the whole surface of the fabric. Formerly, a brush was the means by which damp was imparted to the cloth This is quite satisfactory, but has been in later years succeeded by nozzle or atomizer sprayers. These consist of very fine conical atomizing sprayers, which, being supplied with a mixture of water and air, under pressure spray the goods perfectly even, either heavily or in the lightest vapor, according to the regulation of water and the pressure of air. On leaving the machine, the cloth is rolled with frictional contact with surface of a wood drum under pressure imparted by swivel levers imparted by weights at their ends. Thus the cloth is rolled under pressure.

Where only a light damping is necessary, and a plate damping machine is available, this may be used as for woolens and worsteds, and being often a part of the brushing machine, the two may often be utilized for cotton fabrics.

The many kinds of calenders are as different in construction as they are various in cost. Their requirements are equally wide, from the simple two-bowl calender to the calender constructed for embossing, or with finely engraved rollers for the Schreiner finish.

The two-bowl calender is its simplest possible form, consisting of two rollers or cylinders, one of which is metal fitted with an internal method of heating, whereas the other is a solid roll made of special paper conposition. By means of screws and levers, a pressure is given to these rolls, more properly named "bowls," and the fabric passing between them, is given a simple hot press, flattening the surface of the goods and imparting a lustre. The amount of lustre is regulated by the amount of friction between the rolls, the pressure to which the fabrics are subjected, the temperature of the rolls, the kind of surface of the metallic roller and last, but not by any

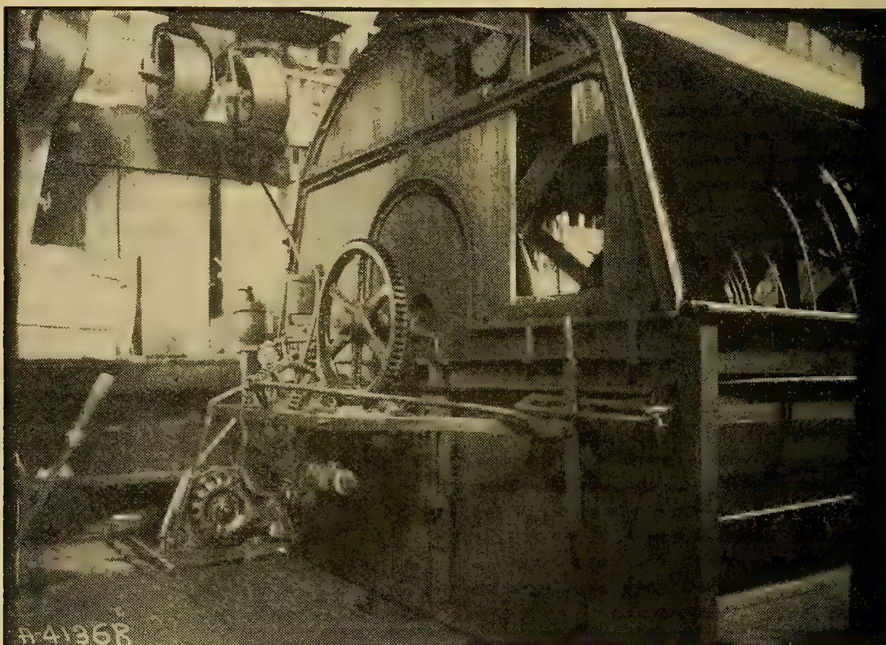


Fig. 6. An Individual Motor Drive for Dyeing Machine.

means of least importance, the amount of sizing previously used in starching or stiffening the goods.

HEATING THE ROLLERS.

The heating of the rollers is done by iron metallic bars heated red hot and inserted into the bowl; and this process is not yet antiquated and out of date. Gas heating and steam heating are not generally used. Steam heating is often resorted to as the cheaper method, and has an advantage over gas heating in never reaching a sufficiently high temperature to damage the bowls. On the other hand, the lower temperature obtainable often has to be supplemented by an increase in speed and a heavier pressure in order to accomplish the same result. Wherever a calender is desired of general utility, say, for instance, in a small plant where only one machine is necessary, the gas-heated bowl is to be advisedly chosen, it providing a wide range of temperature for all classes of work. For the finishing of medium and heavy grades of cotton duck, a two-bowl calender may be employed having two metallic bowls, both supplied with heat. These bowls are about thirteen inches in diameter and able to have a high pressure exerted by upper screws. Seldom more than a four-bowl calender is to be met with, although they may be found with up to eight and ten bowls.

A COMBINATION MACHINE.

In the finishing of duck and all classes of plain cottons, the three processes of brushing, dampening and calendering are brought about by one machine in combination. This entails a large saving in labor and time, besides having the additional advantage of large economy in floor space. A machine of this kind is built by the Curtis & Marble Machine Company. Coming from this machine, and the usual terminating process in the actual finish being on the calender, the goods are at open width. They are now to be rolled on cardboard cylinders, cardboard or wooden piece boards, to be measured and packed for shipping. A rolling machine is usually supplied with measuring equipment attached.

Previous to rolling, however, should the goods be double width, a cloth folding machine is necessary, so that the cloth may be folded lengthwise and sent out in compact form. A folding machine is not in all places necessary, depending on the class of goods produced. It consists essentially of two adjustable bars, which, meeting the cloth in the centre, draw it between them, and in so doing, make a fold, the exact centre of the cloth being arrived at by an adjustment of the two bars.

WINDING AND MEASURING.

The cloth then goes on to the rolling machine or what is called a winding and measuring machine, which, as such, may be seen in any New York merchanting house. The board is fitted into the clamps, the measuring clock put at zero, and the piece started winding onto the board. The machine, being worked by a treddle, may be rapidly stopped and started. The goods may be wound on square bars or flat plates to be drawn out after the goods are rolled up. Tension is put upon the rolling by tension rods, allowing the goods to be wound hard or soft as desired.

The amount of dyeing and finishing machinery required, compared in proportion to the other machinery in a plant, cannot be estimated, requiring sometimes more, sometimes less, according to the class of goods produced and the quality of dyeing and finishing demanded. The output for any given machine is again an ever varying quantity, and usually, both finishing and dyeing, when reduced to a question of machinery producing so much in so much time, invariably degenerates the quality of the work. A calender may do its work satisfactorily the first time, or it may require the piece to have a second or a third run. Again, a jig should turn out five lots of black in a day, and size straight colors. On the other hand, it may take a day to turn out one of either. The jig should be equal to thirteen looms in a place of some size, but in the small place,

a dyer cannot turn out varieties of shades without a number of jigs for his different colors, three at the very least.

PROPER PLACE FOR SLASHING.

The slashing machine is sometimes met with in the finishing department. There is no objection to this, excepting that the yarn, having been beamed on the slasher, should not be allowed to lay about any section of the finishing room likely to impart moisture to the goods. Slashers are much more likely to fit into the general mill system when placed in the warp dressing room, to which place they properly belong.

One word about belting in the economy of the dyehouses. The belting account is one which can be largely diminished by a good choice of belting. Canvas belting will stand the steam superior to leather, with the disadvantage of being short-lived and not easily mendable. A good quality of canvas belting is, nevertheless, to be recommended for most dyehouse purposes. Where the belts are to be crossed for reversing motion, then some of the mineral tanned leather is to be recommended, and it is purely a question of price as to whether this article cannot replace canvas belting throughout the dyehouse.

At best the belting proposition is an expensive and troublesome detail, which has to be carefully considered. The accompanying illustration, Figure 6, shows a small induction motor connected to a dyeing machine by gearing. The first thought of the dyehouse man, is that an electric motor will last almost no time where acid fumes and moisture prevails in such large quantities.

This is not so, as actual motor installations have proven the contrary. Motors are built with special attention to the use they are to receive, and by installing motors designed for dyehouse work, good results can be obtained.

The coils of the motor are specially insulated to prevent harmful action from the moisture and acid fumes, and the need of belting is eliminated.

The motor shown was put in to replace a belt-drive, which was requiring renewal constantly. The motor has been in constant use something over a year, and has given no trouble.

It is interesting to note that a fitting in the water pipe near the motor became loose and allowed the motor to be badly flooded with water shortly after its installation. A certain time was allowed for the windings to become partially dry, and the machine was again started without accident.

RAW STOCK AND YARN.

Raw stock and yarn, scouring and drying machines have not been considered, their general simplicity of construction and application being known. Drying is often done by laying the stock out in the open air, likewise with the yarn in open frames. Scouring, on the other hand, is done in almost any shape of cistern, with any quantity to suit general convenience.

Just a word is necessary in the dyeing of sulphur colors on raw stock, where an advantage is gained in keeping the concentrated sulphur liquor to be used as a standing bath. A V-shaped pipe is fixed into the bottom of the cistern, connected to a centrifugal pump. This pumps the liquor either into the next cistern or into a trough fitted overhead; again, it is often arranged in such a manner that the liquor runs into an underground tank, afterwards to be pumped back into the same cistern when a redyeing is ready, the old one having been washed and removed. Any of these, or a combination, may be used for economy of sulphur dye-liquor, and is certainly well worthy of application.

ONE UNFAILING ECONOMY.

There is one never failing economy in the dyehouse sometimes apt to be lost sight of. Hundreds of dollars can be lost in the dyehouse in a very short time and still the work might be going on satisfactorily to all appearances. A good dyer is always a good investment. He is always worth his money, even if it will only be in an economy of dyewares, but he saves it in time, labor, steam, claims, and numerous other ways in which the dyer can make or mar the fabric.

Dyers are a class of very honest men, but as a matter of business, 80 per cent of them take commission on dyeware orders. This delinquency is a matter of much diplomacy on the behalf of the manufacturer. He often resorts to the expedient of buying all his colors from one color concern. This is a wrong method of obtaining the end. A dyer should have a free choice in the question of coloring matters, since that is his business and not the manufacturer's. The manufacturer, whatever means he should pursue to stop this practice, ought not in any way to hamper the dyer in his choice of coloring matters, thus restricting a competent man in the exercise of his duties.

The Chemist in the Textile Mill

No one to-day would doubt the statement that few mills in the United States are wholly without the services of a chemist, but it is also a fact that few mill managers are willing to admit that chemists are necessary for them to run their mills successfully.

When a man thinks of a chemist he generally pictures in his mind a few glass bottles and an old man about 75, who is hard of hearing and also hard to approach. The young man graduating from the modern scientific school is an entirely different proposition. He not only has a good working knowledge of chemistry at his disposal but is also somewhat of an engineer.

The manufacturing industries to-day must cut costs every year, if possible, in order to keep on making money. Now the labor cost in manufacturing is, as we all know, a very important factor. We can be sure to make a bigger saving in this department than in almost any other.

RAW MATERIAL

which enters into the manufacturing process may or may not be more important than labor. However, it is hard for the average man to see where a chemist can be of much value in lessening the labor cost. Perhaps it would be well to start first in the boiler room. When a man is visiting a plant that is generally the starting point. Let us consider then, briefly, what we may expect to accomplish in the boiler room by taking in a young man with chemical and engineering training.

The purchasing of coal, its economical and efficient handling and also the care exercised in running the fire are, of course, the points toward which we may direct our attention. With regard to the purchasing of coal under specifications, the writer has not a great deal to say. We should rather try to get the best coal we can for the money and by that is meant the best coal both in regard to the content of heat units as well as the properties which affect its economical handling and combustion. Is the coal very fine or very coarse, wet or dry, high or low in ash; also does the ash contain much unburned matter on account of its tendency to form slag? These questions are generally factors to be determined by a man of scientific training.

The labor of attending fires and feeding coal to the boilers can be put on a very efficient basis, indeed, by constant study on the part of the fireman, and this, of course, necessitates some attention to gas analysis and temperature measurements of gases, air, water and steam. It is easy to see that the chemist must be able to be a good fellow and mix well with the fireman and engineer. In this way the problems of one become those of both, and each share in using their intelligence for the other's benefit. Many times in the past, chemists of the old type have superficially examined boiler rooms

and impressed the fact of their great knowledge on the poor fireman, who, although not trained along chemical and engineering lines, is

OF GREAT IMPORTANCE

to the successful operation of the plant.

In the writer's opinion, every fireman can be encouraged to handle his job in a more scientific manner, and by this I mean that the company will save money which has hitherto been wasted. It is a well-known fact that gas analysis alone shows us just how much air is being used in proportion to the coal burned. There are plenty of good methods of determining the amount of carbon dioxide in the flue gases, nearly all of which are so simple that the fireman can be taught how to watch his job by this method. The bonus system of payment also acts as a wonderful stimulant to good work. Obviously, a chemical engineer is just the man to install successfully a system which will bring up the efficiency of the boiler rooms, and many up-to-date plants are using just this method of making a little more money.

Very little thought is necessary on the part of a mill treasurer to find that he is making money by employing science in his boiler room, once he can be persuaded to do so. The results should speak for themselves. It can be easily shown that there are two extremes to avoid, viz.: Too much science and too little. A man who has never employed a chemist thinks he ought to be able to answer any and all questions. The man who has had a chemist about the place is generally sure that a bigger fool never existed, and the old saying that a little knowledge is a dangerous thing is here well shown. What is needed is good fellowship most of all. Take a young man from some good technical school and turn him loose in your mill. If all the foremen like him and are glad to have him about the place he can save you money. If he cannot become a good mixer take my advice and don't keep him, because he won't accomplish much.

No one can successfully solve a problem until he has completely grasped the most minute details, and it is obvious that the engineer and fireman are the only ones who know absolutely what the facts are in their departments. If the young chemist gets their absolute confidence he can successfully investigate and think out good schemes, but without this feeling of friendship very little can really be accomplished which is of lasting benefit to the concern in question.

Let us close this article with a short talk on purchasing supplies for the mill. This includes cotton, wool, oil, starch and, in fact, everything used in the manufacturing process. Dyestuffs and chemicals will be left for later discussion, as these are by no means of as great general importance. Cotton buyers, as a rule, have but little knowledge of chemistry. Only the other day the writer was talking with a manufacturer who was being led to believe that real cotton fibre could be obtained from wood. Obviously, an expert would hardly be able to tell the difference without recourse to the microscope. A manufacturer should be enough of a chemist to realize that unless he can make a really scientific study of his cotton, wool, oil, etc., he should be very skeptical about statements made to him by the seller.

It is perfectly absurd in the writer's opinion to dispense with the services of a chemist in buying cotton, wool, oil and starch, and yet there are very few chemists who have enough practical knowledge to be of very much service to the average manufacturer. Few know how much could be saved the average textile mill if there were some means of showing just how inefficiently these articles are being purchased to-day.

There is a big difference in the money value of things which the manufacturer uses, and things which he might use to better advantage, perhaps, were he honest enough with himself to allow a

COMPLETE INVESTIGATION

into what he buys, and the purpose for which it is used. Graft and ignorance combine to make some manufacturers pay twice as much as others for the same thing. Sometimes cornstarch is sold as wheat or potato, which is worse than a crime in this enlightened age.

One instance brought to my notice in regard to oil recently was where a man had in his mill some oil which would serve admirably for use in a new machine which was being installed, yet the foolish man did not dare to try it, even on the advice of a competent chemist, who knew well enough that the oil which was recommended by the man who set up the new machine was not a bit better for that particular purpose than the oil already in the mill. Of course, it is needless to add that the manufacturer forced himself to pay three times the value of the oil.

The fact that the cost of supplies is a small factor in the total manufacturing cost is no excuse for such ignorance on the part of the buyer. Think of how little real scientific investigation is made into the real value of wool, cotton, oil, starch, etc., by the man who uses the goods, or often by the man who sells them. Let us hope that in the future men with scientific training will be encouraged to study carefully and continuously just what grades of cotton, wool, coal, oil, starch, etc., can be used to best advantage. Given some chemical training, backed by a few years of experience, and the average man can uncover big savings in nearly every mill in the land.

The Application of Science to the Dress Room

There is no mill manager alive who will deny that waste exists in different departments of the mill. The chemist who has had a good training can save a great proportion of this if he is given the opportunity. Results count for so much these days that it seems a pity to waste money, time and material in our modern manufacturing industries. Most of the big corporations have a chemist but often he is a figurehead.

Probably, there are some mills where this is not true, but if so, they are not known to the writer. A chemist who has lots of fight in him and is anxious to get results is a great asset in a going concern. The only bad feature of the whole thing is that very few chemists are practical men as well. It is a shame that the average superintendent cannot be made to feel that he pays but little attention to the chemical efficiency of the plant. Armed with a little scientific training a superintendent would be able to cut costs in halves and sometimes thirds.

Let us consider what can be accomplished in the dress room.

THE EQUIPMENT

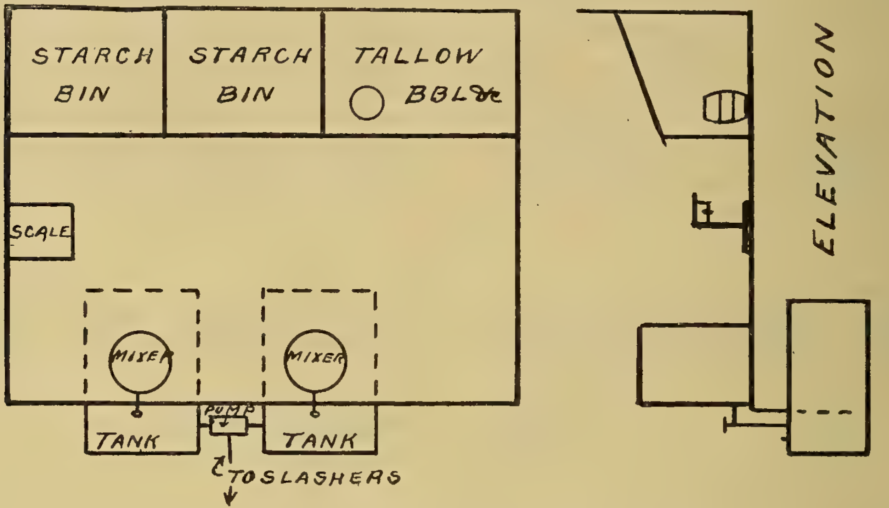
is the first item to engage our attention. Is the tank used for mixing the size located so as to make it foolproof, easily accessible and an efficient machine? The mixers should be placed above the tanks so that the size can be run out and examined before being pumped to the slashers. The accompanying sketch shows this, and also the general scheme. The starch should be weighed out into pails, also all the ingredients ready for each batch. No mistake is liable to happen if this is done, and it should be done while the previous batch of starch is cooking. The method of mixing should be uniform. This result is best obtained by having the same man do it always. He gets into the habit of doing it right and of making every move count and should be well rewarded for his efforts. Some will not agree with me that good wages are the cheapest in the long run, but I

believe it absolutely. If a man gets well paid he takes pride in his work and does not fail to return the extra cost in faithful effort.

CO-OPERATION NEEDED.

None of the above talk has much applied chemistry in it, but the chemist needs a hint or two about the practical side of things nearly as badly in some cases as the practical man does about things theoretical. The scientific man, of course, will see that the man who mixes the size is, first of all, his friend. You cannot accomplish anything in any mill unless you are willing to be a good fellow with the men who do the work. They are on the job all the time and their friendship is necessary in order that the chemist may grasp the details. No man will be very confidential with you unless you are his friend.

In making the size, then, great care is exercised in making conditions uniform. In this way the same results are always obtained. Now, starch is queer stuff. There are all kinds of starches on the market and all kinds of men selling them. Some can use cornstarch, others cannot but insist on using nothing but potato starch. It might be worth while to think for a moment just what it means in money. Cornstarch is worth, say, two cents, while potato is worth four cents a pound.



PLAN SHOWING LAYOUT FOR SIZE TUBS, STARCH BINS &c

Tons of potato starch are thought necessary to-day by men who could use cornstarch and get more uniform results in many cases. Why, then, do they use potato starch? Habit? Not necessarily habit, but you might say faith gained by experience, which is so liable to be based on misinformation that sometimes one is tempted to be like a famous efficiency engineer who never believes anything which he is told until he is thoroughly convinced by a large number of careful experiments. When we find one mill using potato starch, another on exactly similar work using cornstarch and still another on the same kind of work using

SPECIAL MODIFIED STARCHES

at an extra price, we sometimes wonder just what methods have been

taken to decide on what to use and how and when and where to use it.

What, then, are the differences between corn and potato starches, which make men have such decided opinions that for hand weaves and very fine goods potato starch must be used. It is generally true that potato starch will take up more moisture than corn. In other words, it is much easier for the moisture to dry out in a warp sized with cornstarch than when potato starch is used. This causes the starch to knock off in the form of powder in weaving. Surely that difficulty could be easily overcome. There are plenty of ingredients on the market which may be added to the size which will hold on to enough moisture to make the cornstarch work very nearly like the potato starch. Any good chemist will find plenty of chance to experiment here. There are many other characteristics of cornstarch which cause it to be radically different from potato which might be dwelt upon at great length, chief among which might be mentioned the fact that potato starch makes a smooth transparent paste at a much lower temperature than is the case with corn. Of course, it would be easily possible to go on and show where all these difficulties lie and how each could be overcome, but no two mills have exactly the same problem, so we must be general in our discussion so far as possible.

THE AVERAGE SUPERINTENDENT

will tell you that you cannot get as good penetration with cornstarch as you can with potato, but in the writer's opinion the penetration of the size depends more on the temperature and thickness of the size than on any one other point. If cornstarch boils at a lower temperature than potato it is easily seen that the same amount of cornstarch containing less moisture would naturally produce a thicker size, which would, therefore, give poor penetration of the warp. In order to get the same results with cornstarch, we must use about 8 per cent less starch and cook it 15 or 20 minutes longer. It must be applied to the warp at a higher temperature than the size made from potato, and the ingredients added in a little different proportion, so as to give the dried warp the same feel as is obtained when potato starch is employed.

Uniformity in sizing warps can be best determined by accurate test rather than by trying to guess at results in the weave room. The whole object of this article is not to show that cornstarch is better for warp sizing than potato, but to bring out the fact that the application of science to the dress room will make it possible to obtain absolutely uniform results, no matter what variety of starch is used. Uniform results in the dress room based on maximum production in the weave room will return tenfold any trifling expense of experiments by a scientific man in conjunction with the boss dresser, whom, as has been said before, must be a good friend of the chemists in order to get results.

Dyeing and Bleaching Appliances

ARTICLE 1

Many people still regard the industry of dyeing and bleaching as being rather old-fashioned in many of the methods of procedure and accuse it of retaining time-serving appliances which should long ago have been discarded in favor of more modern labor-saving devices. To a great extent, this indictment is, perhaps, true, and many of the appliances to be found in even a modern dyehouse are fashioned after prehistoric models.

With the advent of the newer processes of dyeing, however, brought about by the introduction of the coal-tar colors, there came also a tendency to apply mechanical sciences to the dyehouse, as well as to other departments of the textile mill. In consequence, there has been considerable advance within the last few decades in the direction of using labor-saving devices to replace the old hand methods.

Up to within comparatively very recent times, that is to say, within the last ten years, textile materials have been almost exclusively dyed and bleached in four forms: viz., loose stock (also slubbing, which is handled, in most cases, practically the same as loose stock), skein yarn, chain warps and piece goods. During the past decade, however, a great deal of effort and ingenuity has been spent in the devising of machines and processes for the dyeing of material in the form of cops, cones, tubes, beamed warps and any other suitable and convenient package. This has been quite

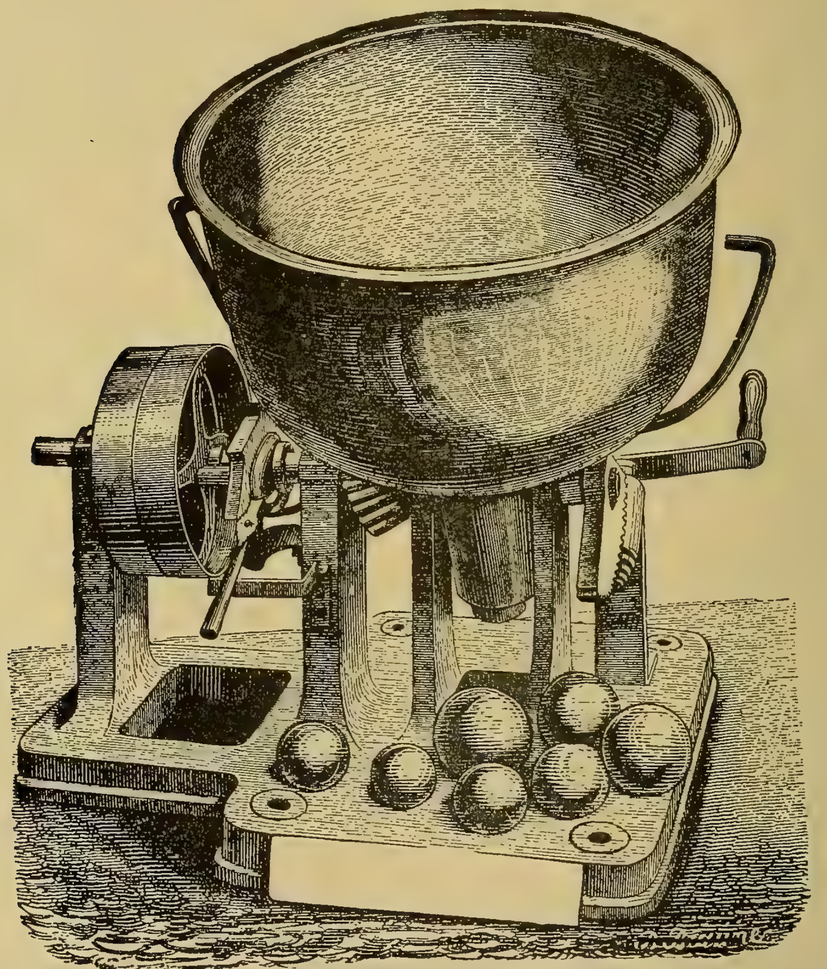


Fig. 1. Indigo Mill. (Ball Form.)

a new departure in the dyeing industry, and although the matter is still really in the experimental stage as yet, nevertheless, the progress already made in this direction shows that it will, in time, become a well-established department of dyeing and bleaching.

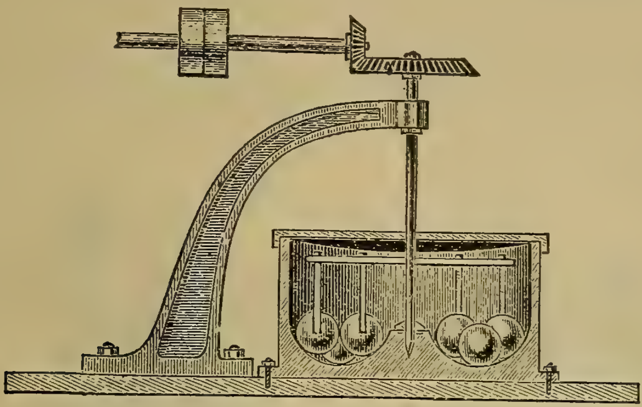


Fig. 2. Indigo Mill. (Another Ball Form.)

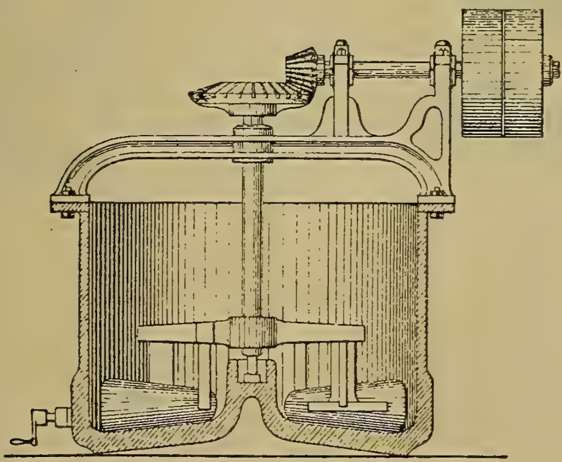


Fig. 3. Indigo Mill. (Cone Form.)

In the old days, when the vegetable dye-woods were the standby of the dyer, the latter himself was generally called upon to prepare the dyestuff in a usable form from the raw dye-wood. This necessitated suitable cutting and rasping machinery for pulverizing the dye-woods to a condition capable of being utilized in the preparation of the dye-liquor. Furthermore, large boiling vessels were required for extracting the coloring-matter from the finely divided dye-wood. These usually consisted of iron or copper vessels, provided with a water or steam jacket so as to avoid

over-heating of the dye-liquor. Generally, round "soup" kettles were employed, with a capacity of 5 to 100 gallons, depending on the size of the dyehouse. For some purposes of dye extraction, closed pressure kettles, or autoclaves were used in which the dyewood could be heated with water under pressure to a temperature above the atmospheric boiling point. The dyer of the present day knows little or nothing of such apparatus. Where wood dyes are still employed, it is now customary for the dyer to use not the raw wood, but an extract prepared by the color maker; and all that is required of the dyer is to dissolve the extract in hot water after the general manner of any other dyestuff. Reference, however, to the older books dealing with the subject of dyeing, will show many illustrations of necessary machinery employed in the preparation of the dye-wood solutions.

ARTICLE II.

Indigo has always been one of the principal dyestuffs employed in all phases of dyeing, and the method of handling it with the dyer has only been changed within comparatively recent times. It was formerly brought into the dyehouse in large solid cubes, about three inches in size. Before the dyestuff could be used in setting the indigo vat, it was necessary to reduce it to a very fine state of division. For this purpose special indigo grinding mills were used, in which the large blocks of indigo were ground down to a fine powder. These mills generally consisted of a revolving bowl, tilted somewhat at an angle, and containing a number of iron balls. As the bowl

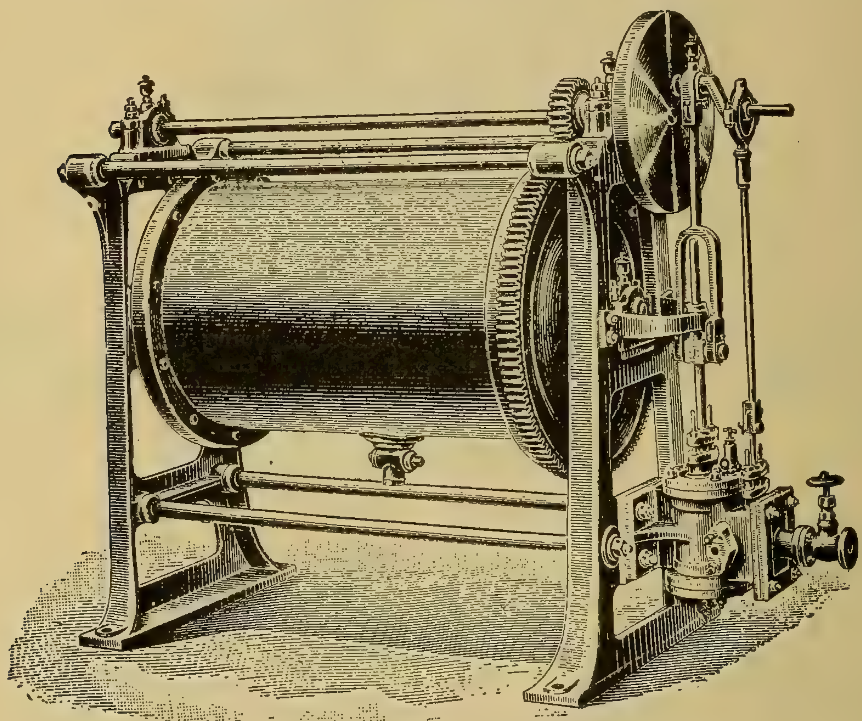


Fig. 4. Indigo Mill. (Cylinder Form.)

revolved the loose iron balls pounded and rubbed the indigo to a powder. It was necessary to continue this grinding for a rather long period in order to obtain the indigo as an impalpable powder suitable for placing in the vat. Even to the present day, there are to be found mills which do their own indigo grinding, but the inconvenience of the process, especially for small mills, has led to the previous preparation of the indigo in a fine powder or paste by the color dealer. This has also been influenced by the fact that synthetic indigo prepared from coal-tar is supplied in this form ready for use in the vat. The result is that, at the present day, it is a rather unusual sight to see an indigo grinding mill in a dyehouse.

MOST COMMON TYPE.

As it may be of general interest, however, the various forms of indigo mills have been herewith shown. The oldest form of machine for powdering indigo was evidently a stamping mill, a figure of which is not given, as this type has long been absolete. The ball mill shown in Figure 1 was a very common type. It consists of a heavy cast-iron circular bowl, so mounted and geared as to turn on its vertical axis which is inclined at a slight angle. Heavy iron balls of various sizes are employed in the revolving bowl for the grinding of indigo. Figure 2 shows another form of this mill arranged on a somewhat different principle. In this form the bowl is circular in section; the bottom is provided with a wide curved groove running around from the inner edge almost to the centre. The bowl itself remains stationary, but the iron balls are moved around in the groove by a rotating forked arm extending down into the bowl. The mill shown in Figure 3 is very similar to the preceding one except that, instead of using iron balls for the grinding, iron cones with rounded edges are employed. A different type from the foregoing is the cylinder mill shown in Figure 4; this consists of a hollow iron cylinder which is mounted so as to rotate horizontally. Inside the mill are two loose cast-iron solid cylinders which do the grinding by the rotation of the mill. The cylinder mill is said to give a larger production, but the ball mills grind the indigo to a finer powder.

ARTICLE III.

The next mechanism to be logically considered in the dyehouse is that to be employed in the preparation of the dye solutions. In the average dyehouse in this country, especially in small establishments, there is not much attention paid to any particular and systematic method of dissolving dyestuffs. Usually a bucket or small tub with an open steam pipe running into it is the only form of apparatus employed. The steam pipe is so arranged that it may be unscrewed from its connection from the main steam supply pipe when it becomes necessary to move the tub away. This is usually accomplished by attendant burns on the hands of the operator who has to unscrew the steam pipe. When looked at rationally, this

METHOD SEEMS CRUDE

and slip-shod in the extreme, and it is surprising that modern mills would permit it. Outside of the crudity of the affair, it is also dangerous to the proper preparation of the dye-solution, for usually the dry dyestuff after being weighed out is put into the tub, which is then almost filled with water; the steam is next turned on until the solution comes up to the boiling point, the solution being stirred in the meantime with a stick. Under these conditions it will be seen that the live steam comes practically into direct contact with the dyestuff before it has been taken into the solution.

This live steam, it must be remembered, as it emerges from the pipe, is superheated (being delivered under considerable pressure), and, therefore, the dyestuff is subjected to an abnormally high temperature, frequently far above the boiling point of water. Such a temperature in many cases is sufficient to cause a decomposition of the dyestuff, which, of course, materially impairs the value of the solution,

and sometimes renders it unfit for use. More careful dyers will always first boil up the water in the tub before the dyestuff is added, and thus the steam is turned off before it can come into contact with the coloring matter.

For the careful and proper solution of dyestuffs, a steam jacketed kettle should be employed, so that the live superheated steam may not come in contact with the dyestuff, and yet allowing of a continued boiling of the solution if necessary. Even in a comparatively small dyeing establishment,

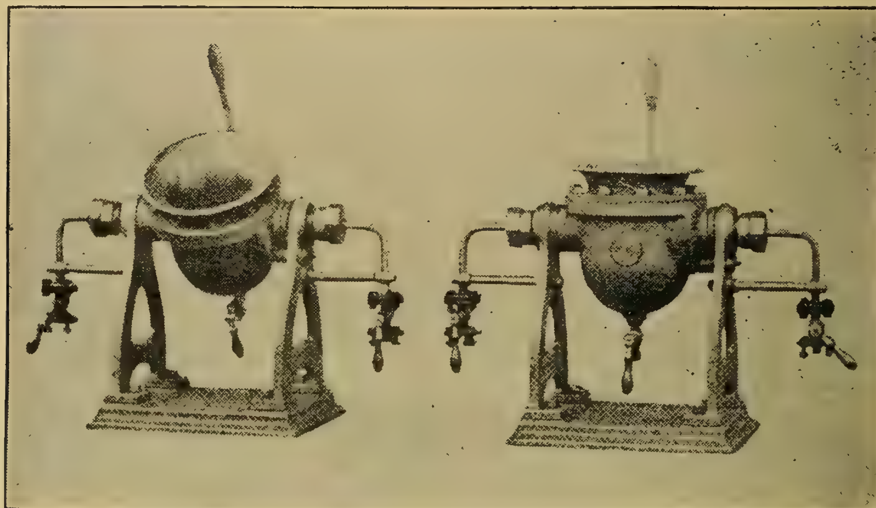


Fig. 5. Jacketed Kettle for Dissolving Dyestuffs.

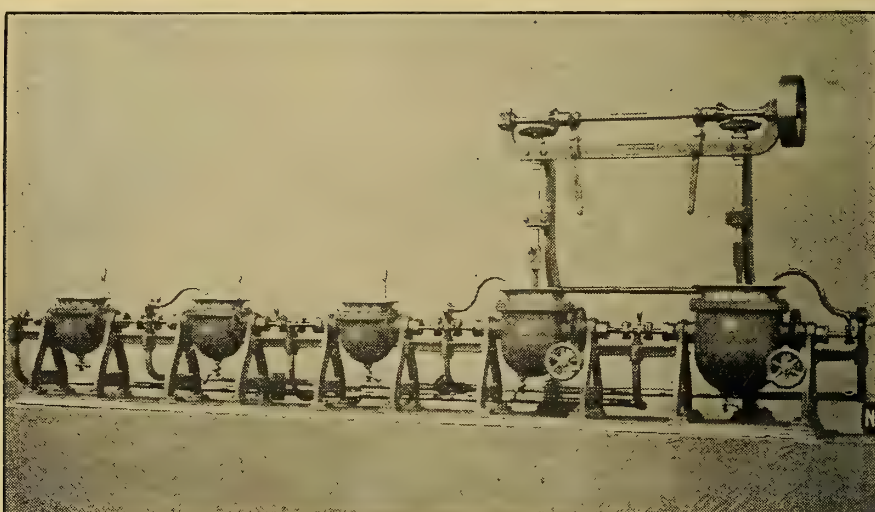


Fig. 6. Series of Boiling Kettles for Dye Solutions, Showing Manner of Arrangement.

such an apparatus should be provided, of a size suitable to take care of the average batch of dyestuff used. In larger establishments, where widely differing amounts of dyes are employed at various times, it is well to have a number of such boiling kettles of varying capacity. These are usually set up in bank in a series, and are generally provided with a mechanical stirrer. The latter is so connected as to be easily removed when it is desired to tilt the kettle over for purposes of cleaning or emptying.

A small-sized boiling kettle for dissolving dyestuffs is shown in Figure 5. This kettle swings on a

HORIZONTAL AXIS

so that it may be easily emptied, and the steam is admitted to the jacket through the axis. In Figure 6 is shown a bank of kettles with three different sizes, the two larger being provided with mechanical stirrers. Complete connections for steam and water are also shown; the water supply pipe is on a swinging joint, so that one faucet supplies two kettles. The three smaller kettles are tilted over by the hand lever shown in an upright position; the two larger kettles are moved by a gear wheel working in a worm turned by the hand wheel shown at one side.

ARTICLE IV.

The time-honored method of dyeing loose stock was to use a round vat, usually of copper. The dyebath was prepared in this vessel, and the loose material to be dyed was poled around in the liquor by means of a long stick operated by hand.

IN THE OLDER FORMS

of such vats the heating was done directly by a fire underneath the vat. Typical forms of these vats are shown in Figures 7 and 8. Although this may seem to us at the present time a rather mediæval method of dyeing, nevertheless, there are still dyehouses in parts of Europe where this antiquated procedure is employed. A familiar and well-known example is in the dyehouse of the Gobelin Works at Paris; and there are, indeed, small establishments in France, Saxony and

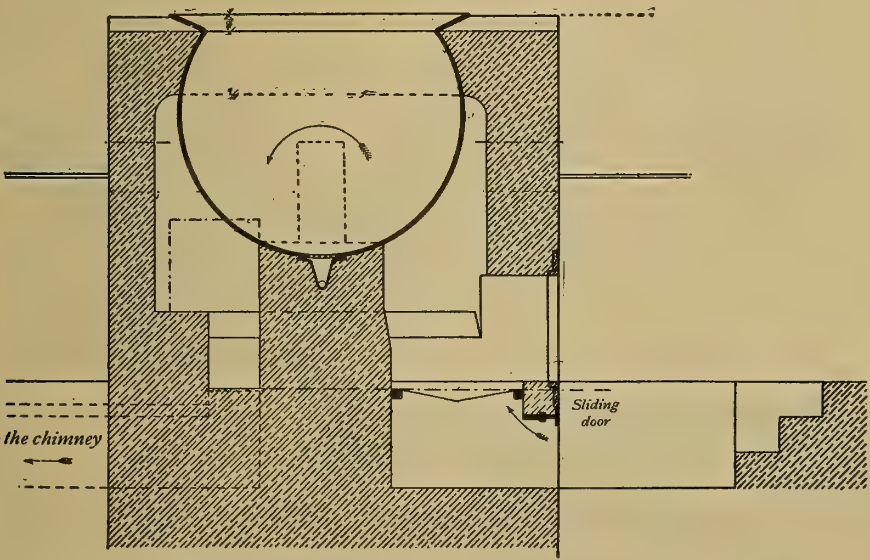


Fig. 7. Vat for Dyeing Loose Stock, Heated by Direct Fire.

Austria where the old copper vats are heated by a wood fire. Of course, in the Oriental countries we would naturally expect to find

THIS PRIMITIVE METHOD

of heating the dye-vat; we would be disappointed if we visited a dyehouse in Persia, for instance, and dyeing is carried on practically as a home industry, the method of steam heating is not permissable.

AVAILABILITY OF STEAM.

In the practical consideration of a dyehouse at the present time, however, there can be no question as to the availability of steam. Dye-vats ar-

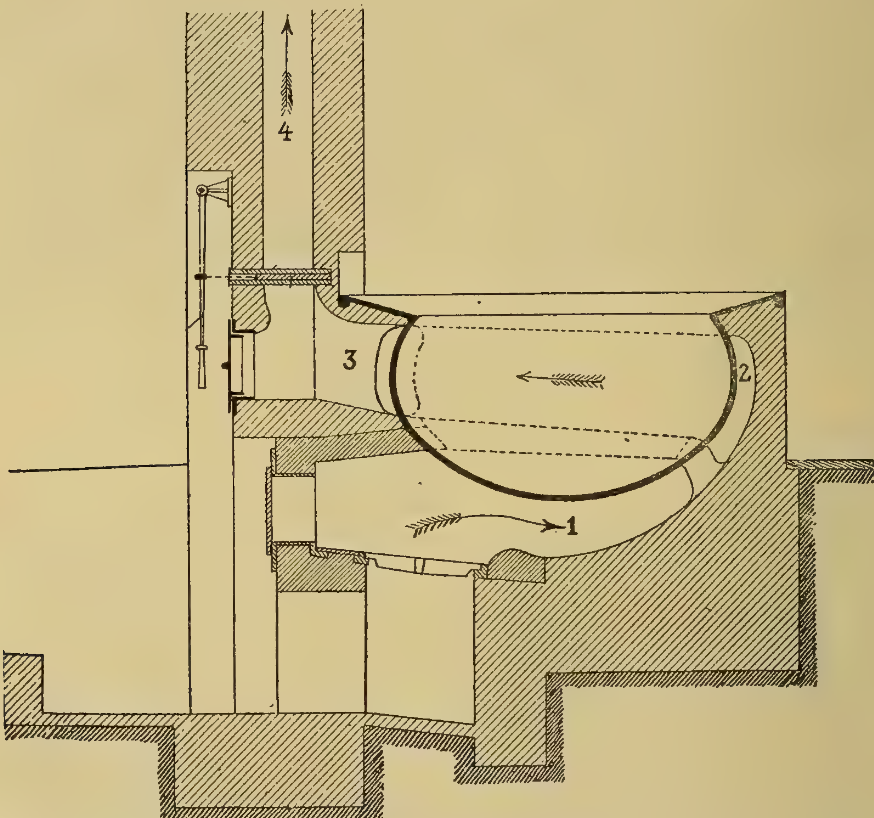


Fig. 8. Showing Another Form of Dye-Vat Heated by Direct Fire.

found anything else—steam heating would be out of keeping with the environments.

The inconvenience and expense of heating the dye-vat with a direct fire soon gave way to the use of steam, when this heating agent came into general use. But steam can only be had where a boiler for its production is available; therefore, we can readily understand that in small establishments in the older countries where the ranged with steam heating were usually large copper kettles provided with a steam jacket; the ordinary type being shown in Figure 9. The waste pipe from the steam jacket, shown on the lower side, is connected by a steam trap. An outlet is also provided in the bottom of the kettle itself for the purpose of running off the contents when the dyeing operation is completed. In Figure 10 another form of vat is shown, which is provided with both

direct and indirect steam heating. The steam jacket is also provided with a safety-valve, so as to avoid too high

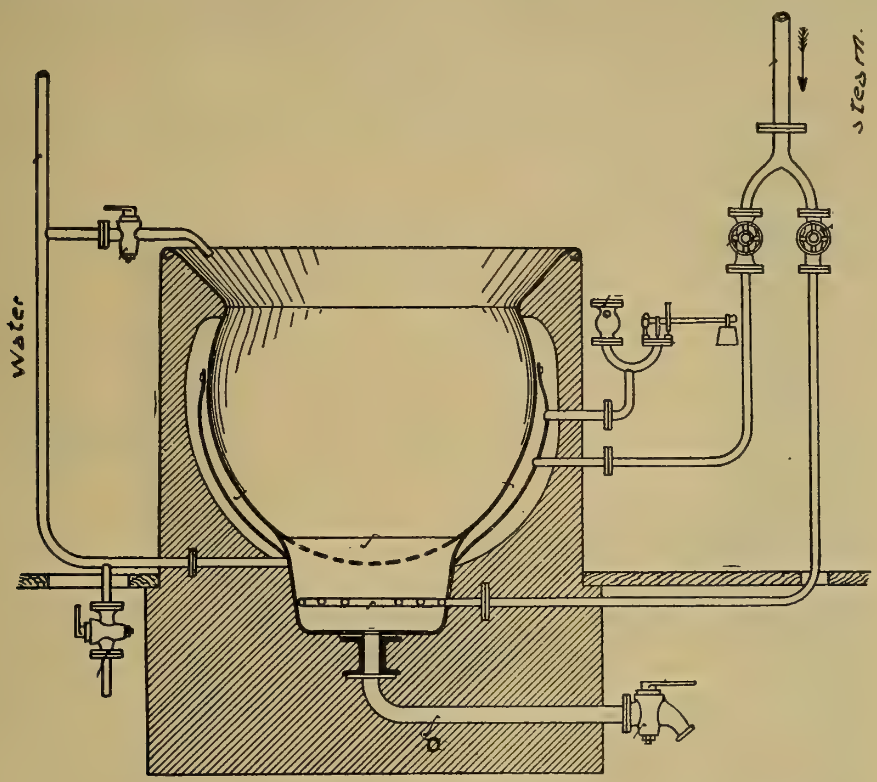


Fig. 9. Vat for Dyeing Loose Stock, Heated by a Steam Jacket.

a steam pressure, which otherwise might bring danger of explosion and also cause overheating of the vat. The direct steam heating arrangement shown in the compartment below the vat proper is simply a perforated steam coil. This is situated in the manner shown so as to avoid the possibility of the live steam coming into direct contact with the material being dyed, the latter being held up in the vat proper by means of the perforated bottom.

ARTICLE V.

In former times, the vats themselves were generally made of copper, but from the fact that at the present time there are a large number of dyestuffs in general use which are badly affected by contact with copper, the metal of the vat has been modified by using tinned copper. However, metal kettles are now only employed for small sizes, the larger vats being nearly always constructed of wood. The usual form of the latter is a round upright tank, slightly larger at the bottom than at the top. It is provided with a perforated false bottom, under which are located the steam pipes for heating. When direct heating with live steam is employed, a single coil of perforated pipe is used; when indirect heating with a closed steam pipe is used, the coil consists of a number of turns, and the outlet runs into a steam trap. These steam pipes should be made from copper or bronze, in order to pre-

vent iron rust from contaminating the dye-liquors. The vertical connecting steam pipe running down into the vat should be enclosed in a wooden partition to avoid direct contact with the dye-liquor. Figures 11 and 12 show such a vat provided with a coil of perforated steam pipe. From many considerations,

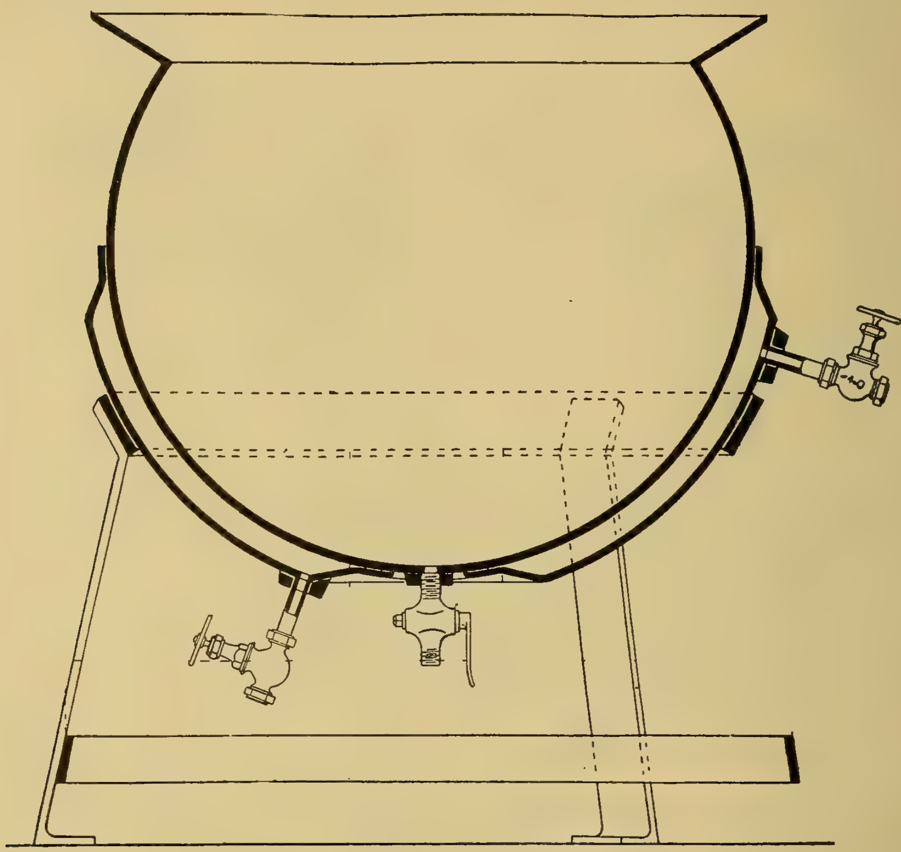


Fig. 10. Dye-Vat Provided with Direct and Indirect Steam Heating.

THE CLOSED COIL METHOD

of heating is to be preferred to that of the open coil. The latter causes a considerable increase in the volume of the dyebath (and consequent dilution) from the condensation of the steam, and this steam will frequently contain oil, and so contaminate the dye-liquor. Again, the live steam blowing up through the liquor may cause a felting or matting of the material being dyed, a bad feature, especially noticeable in the case of wool. The use of live steam, also, unless its supply is carefully regulated, is liable to cause an overheating of the fibre and an undue ebullition of the dye-liquor.

For the purposes of giving even and well-penetrated dyeings, it is necessary to circulate the material being dyed in a more or less

SYSTEMATIC MANNER

through the bath. In the form of vat just described, this is usually accomplished by "poling" with long sticks. If this were not done, uneven dyeings

would result, for the lower part of the vat, of course, is heated sooner and to a greater degree than the upper portion, as it is in more direct contact with the source of heat. When successive portions of dye-liquor are add-

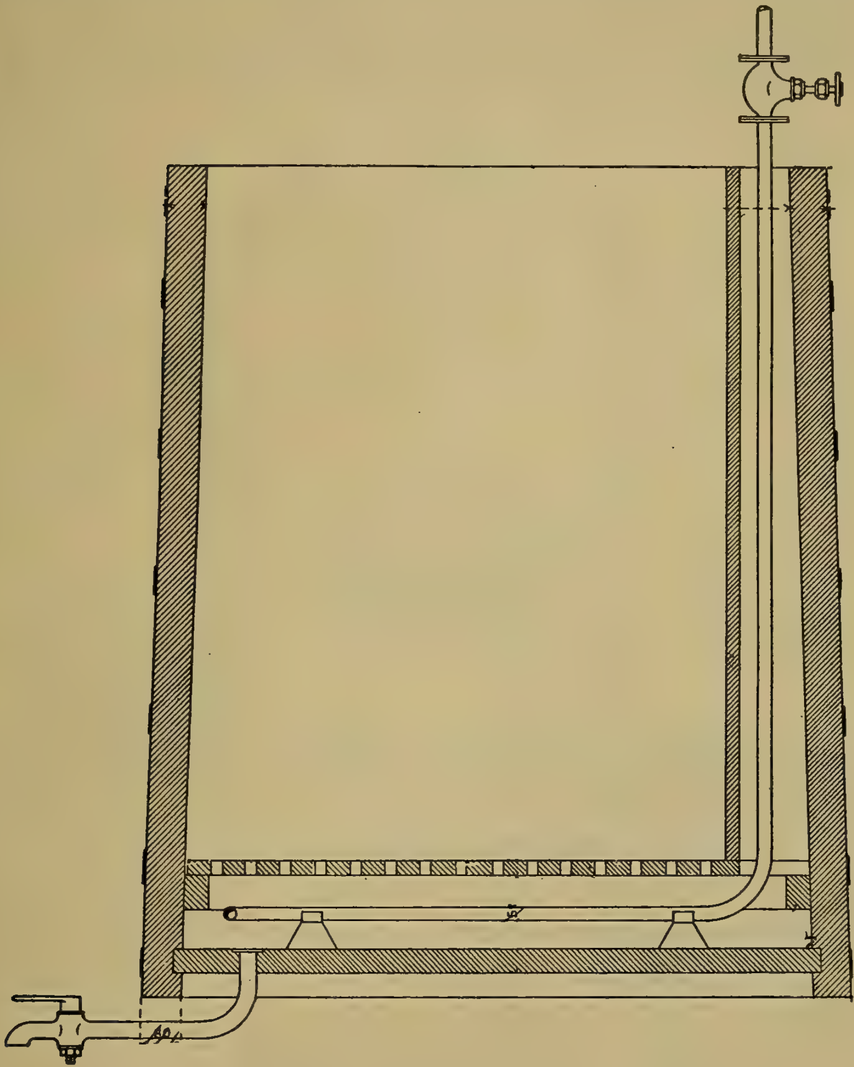


Fig. 11. Round Wooden Dye-vat, Vertical Section.

ed, it is also necessary to circulate the bath well so as to avoid more of the color going on the upper parts of the material than on the lower. This poling of the goods, however, especially in the case of wool, is liable to cause a felting of the fibre, which much deteriorates its value for after processing. To get away from

THIS OBJECTIONABLE FEATURE,

some dyers place the loose stock in a net or cage and suspend it in the dye-liquor in this manner. By arranging an overhead pulley this cage with its contents may be lifted out and let down into the liquor with comparative

ease, and by doing this systematically, a sufficient circulation in the dyebath may be obtained without any danger of

FELTING THE FIBRE.

It also affords a convenient method for removing the material from the bath after the dyeing process has been completed, and of allowing the excess of liquor to drain back into the bath. If a series of successive operations are required in the dyeing process, such, for example, as mordanting, washing and dyeing, a set of vats may be employed with an overhead tackle and runway. In this manner, the cage with its contents may be easily lifted out and transferred from one vat to another without unnecessary handling. Such an arrangement is shown in Figure 13.

With regard to the size of vats (in almost any connection) required for any desired amount of loose stock, it may be said that one pound of loose cotton will require about 2½ to 3 gallons of liquor, and one pound of loose wool will require just about twice as much, or 5 to 6 gallons of liquor, so the size of the tank must be calculated in accordance with these requirements, and additional space for false bottoms, etc., must also be allowed.

Yarns and manufactured goods will not require quite so much volume as loose, as the material is in a more condensed condition.

VARIOUS METHODS DEVISED.

The inconvenience of handling loose stock in the open vat methods which have just been described, and the consequent injury to the fibre by the handling necessitated, has led a number of dyehouse engineers to devise various methods and machines for the proper handling of such materials. The customary object held in view in the construction of these machines has been to agitate the fibre as little as possible so as to reduce the amount of felting and matting; to circulate the liquors through the material as uniformly as possible so as to avoid uneven dyeings; and to provide convenient means of loading and unloading the apparatus so as to cut down the amount of labor required to a minimum; and, finally, to have the apparatus run in such a manner as to be more or less what may be termed "foolproof," so as to allow of a low-grade labor being employed in its operation.

Two very successful machines which have been largely used in this country for the dyeing of raw stock are the

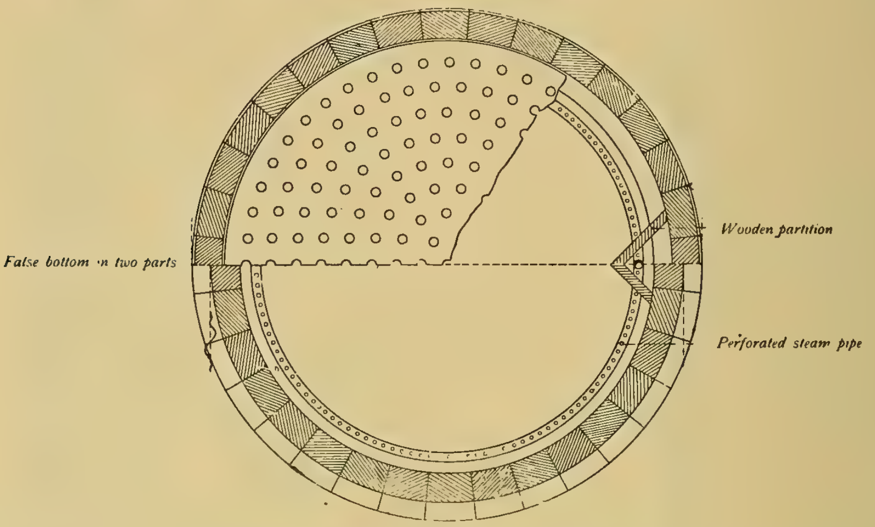


Fig. 12. Round Wooden Dye-vat, Cross Sections Top and Bottom.

Klauder & Weldon and the Delahunty. These two machines are grouped together, because their general method of operation is very similar. They differ, however, in certain details of construction and manner of working, and these points will be taken up in the discussion of the machines.

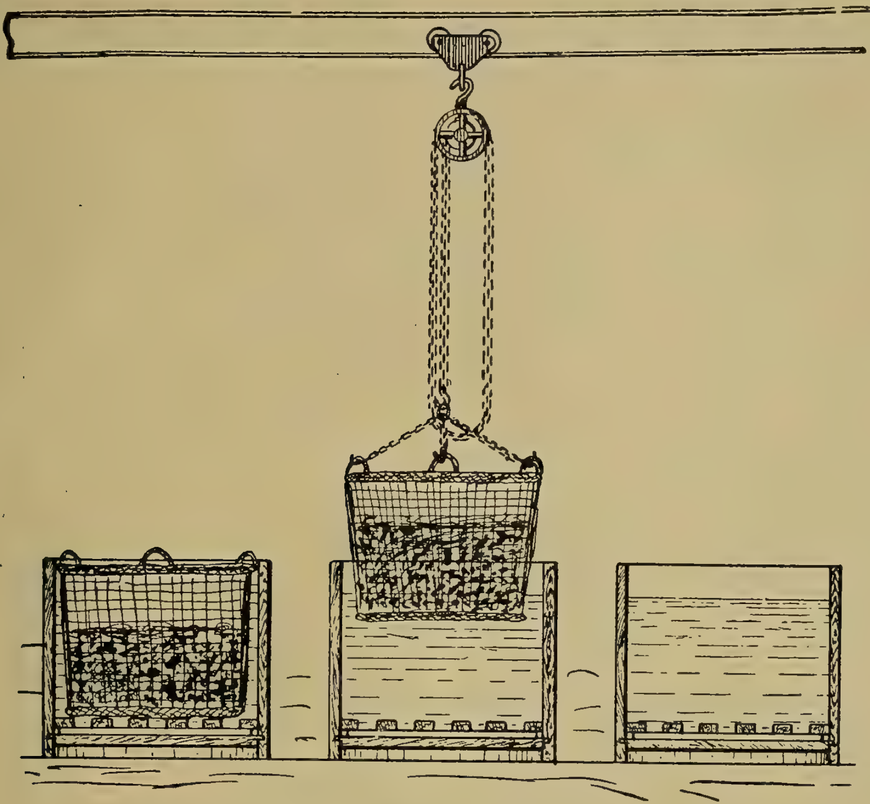


Fig. 13. Series of Vats for Dyeing Loose Stock.

ARTICLE VI.

In the forms of dyeing apparatus for loose material which have so far been discussed, the liquor in the dyebath has been held in one vessel, while the material being dyed is circulated or moved through it by one means or another; and, furthermore, the material has been left in an open condition, and has not been subjected to pressure. In considering the dyeing of loose material by mechanical means, it would soon naturally appeal to the textile engineer to employ a suitable mechanism whereby the material being dyed can be compressed into a compact mass in a proper container, and the dye-liquors then forced through this mass by pumping or other means. This system of dyeing has rapidly developed during the past few decades, and a large number of different machines have been constructed in an endeavor to realize the best conditions of successful operation. This system of dyeing may be called with proper significance

THE "PACK SYSTEM,"

in so far that the material is packed into the dyeing receptacle, or it is also known as the "circulatory sys-

tem" by reason of the fact that the dye-liquors are circulated through the material during the dyeing operation.

The pack system would seem to offer a number of advantages over the older method of hand manipulation in that the material being dyed is handled with a minimum expenditure of labor, and that this labor is mostly controlled by mechanical forces and eliminates to a very large degree the costlier hand labor. Furthermore, by handling the material in a compact mass, economies of steam, water, dyestuffs and chemicals could be introduced, and there would be less waste of these items, as well as less waste of material. Again, since the material in this system of dyeing remains in a quiescent state during the entire process, there is practically no mechanical agitation of the fibres such as is the case when the material is treated by hand, or even when it is treated in the other forms of dyeing apparatus where the material is carried through the dye-liquor. This feature would seem to eliminate almost entirely the fault of matting and felting of the fibres which afterward causes so much waste and bad work in the carding and spinning of stock dyed material. This feature in fact has always been the principal drawback in the dyeing of either cotton or wool in the loose state, and it has only been the overcoming of this felting and tangling of the fibres by means of proper dyeing mechanism that has allowed of the very great extension of the use of stock-dyed material in the spinning of yarns.

There are

TWO CLASSES OF MACHINES

incorporated under the general type of pack dyeing. In the first of these, the material is not packed into the receptacle with any special idea of compression. It is simply contained in a closed vessel and the dye-liquor is circulated through it by suitable means. In the other class of machines, the material is tightly compressed into the dyeing receptacle, and the liquors of the dyebath have to be forced through the compressed mass of fibre by high pressure obtained by means of a pump or air pressure. In the first class of machines it does not require any great force or pressure to cause the dye-liquors to be maintained in a constant circulation, and usually the lifting power of live steam, blown into the liquors after the manner of a simple injector, is sufficient to bring about the required circulation. Aside, howev-r, from any differences in the method of producing the circulation, there is also a considerable difference in the character of the packing to be observed in loading the machine. Where the material is under strong pressure, it is essential that the packing be carried out in such a manner that the mass of fibre will offer as nearly as possible an equal resistance at every point to the flow of the liquor through it. If this resistance or density of the packed material varies from point to point to any considerable degree, there will be the inevitable result of

CHANNELLING

of the liquor in its passage through the mass; that is to say, the liquor will naturally follow the line of least resistance and where the material is packed more loosely, the liquor will flow through freely, while where the material is more tightly packed, the resistance may become so great that no liquor at all will pass through, and consequently there will be an irregular distribution of the dyebath and accordingly the color will go on the material unevenly.

We will now take up a consideration of the principal forms of dyeing machines where the material is packed in the loose condition. These are usually of a very simple construction, and as no special pressure is required in the machine, the parts need not be of any particular strength. The general principle of construction may be described as follows: A tank, usually of wood, forms the dye-vat; the central portion of this tank is occupied by a perforated receptacle to contain the material to be dyed. This receptacle may be of wood or of a suitable metal, or even consist simply of perforated upper and lower partitions to separate the material from the dye-

liquor. The lower part or bottom of the tank furnishes a reservoir in which the dye-liquor is heated.

ARTICLE VII.

In Figure 14 is given a schematic drawing showing the general principles under which this form of dyeing machine is constructed and operated. The tank is divided into two small (A and C) and one large (B) compartments by means of the two perforated partitions (T and T'). The material to be dyed is packed in the large middle compartment (B), and the lower compartment (A) is supplied with a steam coil (S) for heating the dye-liquor. A pump (P) provides a means of circulating the liquor from A to C or in the reverse direction.

THE PRINCIPAL DIFFICULTY.

to be overcome in the pack system of dyeing, whatever construction the machine may have, is the even penetration of the dye-liquor through the entire mass of fibre. In the simple scheme shown in Figure 14, the dye-liquor is drawn by the pump from

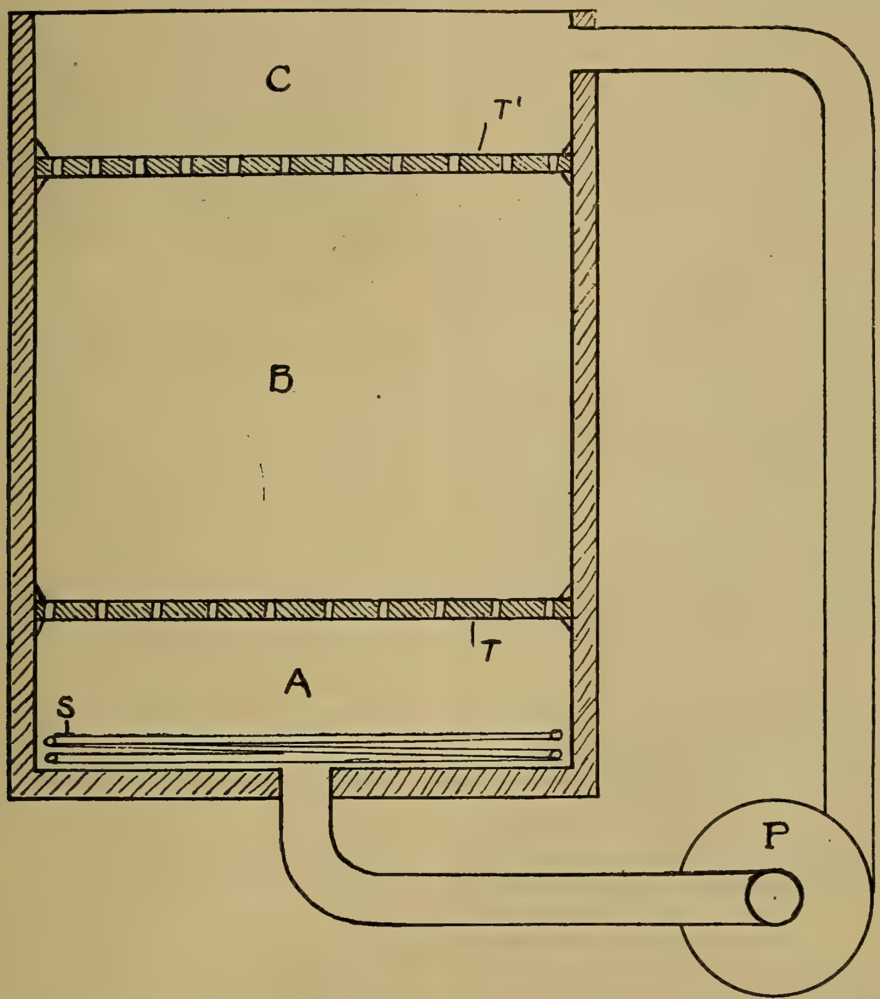


Fig. 14. Showing General Prin ciple of Pack System of Dyeing.

the compartment A and forced up to the compartment C, from where it trickles down through the material in compartment B. When either wool or cotton in the loose condition is wetted, it becomes rather compact in mass and will offer considerable resistance to the passage of the liquor through it. On the other hand, the strong capillarity of the fibres in absorbing the liquor aids very materially in the flow of the liquor. Furthermore, the suction exerted by the pump on the lower compartment also aids largely in drawing the liquor back from C through the material in B, and finally into the reservoir A again. There are some disadvantages, however, in the form of apparatus where the flow of the liquor would be maintained continually in this direction; that is to say, from C through B to A, and then back from A to C by the pump. In the first place, the pressure of the liquor from the top, and also the weight of the upper layers of the material on the lower, cause these lower layers to become more tightly packed down than the upper layers, in which the fibre would be more free and open. This would have a tendency to give the upper layers of the material a more thorough dyeing than the lower ones, and hence result in uneven and

SHADED COLORS.

In the second place, if the liquor is continually circulated in the one direction, from the top downward, the uppermost layer of the material in the compartment B will act as a filter surface to the liquor, and will catch all insoluble matters contained in the liquors, such as miscellaneous dirt, undissolved particles of dyestuffs or chemicals, and lint, etc. Under the best conditions of dyeing and the preparation of the dye-liquors, there will always be more or less of such materials which will filter out in this manner. The result may be that the upper layer of the material will be more or less injured in quality. In order to obviate these troubles, it is best that the flow of the dye-liquor should be reversed in direction from time to time. By reversing the pump, the liquor would then be forced from A up through the material being dyed and overflow into the top compartment C from where it is drawn by the pump back again into A. When the liquor flows in this direction, the lower layers of fibre in B will be lifted against gravity, and thus the mass of the material will be loosened up, while on the other hand, the upper layers will now become compressed against the partition T'. This reversal in the direction of the flow of the liquor also tends to clean up the upper layers of fibre and remove the insoluble matters which may have become filtered out when the liquor was running in the opposite direction. By this means, a more

PERFECT UNIFORMITY

of treatment may be obtained and, consequently, the resulting color and condition of the material will be more even.

Having considered the theory of this method of dyeing, we will now consider a few of the chief types of machines which are constructed in accordance with this general principle.

The Dreze machine is one of the simplest forms of this type. The diagram of this apparatus is shown in Figure 15, an examination of which will show the general idea of its construction. The container in which the material is packed consists of a copper cage with perforated top and bottom and with a round canal or tube running through the centre. This cage is filled with the loose wool or cotton to be dyed and then lowered into the dye-vat, in which it fits in such a position that an open steam jet comes directly beneath the central opening. In the operation of this machine, the steam is turned on, and this jet which is underneath the dye-liquor acts as an injector, and carries the dye-liquor up the central opening and spreads it over the perforated top of the cage. From there it is sucked down again through the material into the lower reservoir. The feed pipe at the side of the machine is for the pur-

pose of allowing additions of dye-solution, etc., to be added during the dyeing process. This machine, though of attractive simplicity, has some serious defects. In the first place, the liquor can only be circulated in the one direction, which fact, as we have already pointed out, leads to certain bad results. In the second place, as the circulation is maintained by means of a live steam injector, the liquor will soon become heated to the boiling point, and then, instead of the steam injector lifting much of the liquor, only steam will blow up through the central channel, and the proper circulation of the liquor will almost entirely stop. Furthermore, by the use of the steam injector blowing directly into the dyebath, the liquor will soon become considerably diluted through the condensation of the steam. Notwithstanding these defects of construction, this machine has had considerable use in Germany for the dyeing of loose wool and combed tops, and has apparently given very

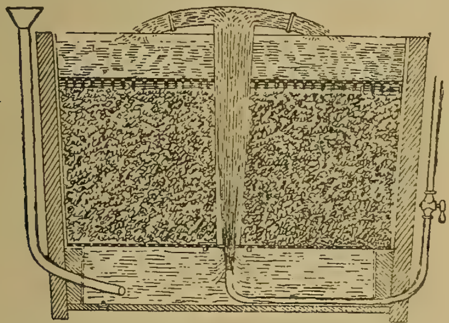


Fig. 15. The Dreze Dyeing Machine.

good satisfaction in a number of places, especially for the dyeing of alizarin colors. The customary size of the apparatus is about 3 feet high and 5½ feet in diameter, and about 250 pounds of loose wool or about 300 pounds of tops may be handled in a batch. By properly regulating the force of the steam at the injector, it is possible to control easily the velocity of the circulation. When the apparatus is first started up and the steam valve turned on but slightly, the liquor wells up through the central canal in a slow moving steam and becomes heated up gradually. As the dyeing progresses, the steam is turned on with more force and the liquor is accordingly circulated with more vigor.

ONE GOOD FEATURE

which is put forth for this machine is the fact that the material is not tightly packed together at any time during the dyeing operation, but is left in a free and loose condition; consequently, there is little or no felting produced, and there is every chance for good uniformity of color. That this machine is a distinct advance over the usual form of open tank dye-tub for loose wool there can be no question, and not only does it keep the fibre in a much better condition, but there is also a considerable saving in labor cost and amount of steam used. This machine has quite a vogue in Belgium, where large quantities of loose wool and tops are dyed for the mills. Its cheapness and simplicity of construction and operation are strong recommendations to a great many dyers.

A Cotton Mill Dressing Room

The dressing room here described consists of two sections, the coarse and fine and had besides the overseer and one office clerk, the following:

Fine section.	Coarse section.
1 second hand.	1 second hand.
1 third hand.	1 third hand.
1 beam man.	2 trucking men.
1 yarn boy.	2 beam men.
1 warp man.	2 yarn boys.
1 beamer (leno).	1 warp man.
5 slashers.	1 warper man.
2 helpers.	5 slashers.
	2 slasher helpers.

Second-hand web drawing.

1 harness repairer.
1 harness cleaner.
1 man to prepare harness for fancy work.
24 girl spoolers, 80 spindles each in No. 34, 40, 50, 60, 70. 80, 90, 105.
3 girls. 12 warpers, 4 each, 2 tie-over girls.
2 girls, 10 warpers, 5 each.
36 girl spoolers, 40 spindles each, No. 7, 12, 13, 15 and 18.
16 warpers, 2 front girls.
4 tie-over girls.
4 girl skein winders.
36 drawing-in girls.

We will prepare warps for 2,400 looms, 300 on fancy in 1, 2, 3, and 4-beam work, 1,344 on fine goods and 756 on coarse goods.

The styles of goods made are lenos, stripes, checks, twills, dimities, colored stripes, spot prints, percales, reps, organdies, combed lawns, India linons, khaki duck, sheeting, prints and bagging.

The warp yarns are frame spun, 23,020 spindles on numbers from 7 to 18, inclusive, and 35,628 spindles on No. 34 to 105.

The number, stock and staple used were as follows:

No. 7 waste.	
12 carded middling ⅞.	Single roving.
18 carded middling 1⅛.	Double roving.
34 carded peeler 1 3-16.	Double roving.
40 carded peeler, also combed peeler 1¼.	Double roving.
50 white and brown Egyptian 1⅜.	Double roving.
60 combed peeler 1⅜.	Double roving.
70 combed peeler 1½.	Double roving.
80 combed peeler 1½.	Selected.
90 Georgia Sea Island, 1⅝.	
105 Florida, 1⅝.	Selected.

Twist in warp was square 4.5 and square 5.

The overseer is notified from time to time of any changes made in the spinning room spindle assignment.

To meet this change of conditions, the following Table 1 will indicate method of assignment per spindle of spoolers and warper.

TABLE NO. 1.

No.	Spindle spinning.	Pounds, product.	Spindle spooling.	Warp'g
7	 416	416	35	.5
12	....16.102	9,340	934	11.7
18	.... 6.512	1,888	236	3.5
34	 1,152	265	80	.8
40	 1,984	337	121	1.13
50	15,056	1,807	904	6.95
60	 9,248	693	433	3.30
70	 1,040	54	36	.38
80	 1,040	47	40	.47
90	 5,168	207	207	2.98
105	 940	30	38	1.27

The list is worked out by using the following production table:

TABLE NO. 2.

No.	Spinning.	Spooling.	Warping.
7	........1.	12.	820
12	.... .58	10.	800
18	.... .29	8.	540
34	.... .23	3.3	330
40	.... .17	2.8	297
50	.... .12	2.	260
60	.... .075	1.6	210
70	.... .053	1.5	190
80	.... .045	1.2	100
90	.... .040	1.	70
105	.... .032	.8	30

This table is based on actual everyday conditions in a mill. From Table No. 1 the overseer makes out a list for each second hand. The headings of each column on Table 3 will explain its contents. The second, third, fourth, sixth and eleventh columns are standards to the number of yarns which they are opposite:

TABLE NO. 3.

1	2	3	4	5	6	7	8	9	10	11	12
Numbers.	Standard set length.	Scores.	Section beam from 1 tie-over.	Available yards on spools.	Size of spools.	Average ends on beam.	Pounds per beam.	Diameter of yarn.	Breaking strength.	Diameter of flange and barrels.	Constants.
7	6,000	2/3000	.1	6,000	5×6	239	244	66	...	8-24	1.02
12	12,000	3/4000	1	12,000	5×6	300	357	83	159	8-24	1.19
18	17,400	4/4350	1	17,400	5×6	310	356	106	107	8-24	1.15
40	19,669	6/3278.2	2	40,268	4½×5	500	292	158	61	9-22	.585
50	16,391	5/3278.2	3	49,173	4½×5	600	234	177	48	9-22	.39
60	9,834.6	3/3278.2	3	29.503.8	3½×4	625	122	193	39	9-18	.195
70	9,834.6	3/3278.2	3	29,503.8	3½×4	650	108	209	33	9-14	.167
80	10,092	2/5046	3	30,276	3×3¾	700	105	223	28	10-16	.15
90	10,092	2/5046	3	30,276	3×3¾	750	100	235	25	10-11	.133
105	10,092	2/5046	2	20,184	3¾×2½	800	91	254	21	10-11	.1144

With spools of various sizes, the change of guide traverse was troublesome. The spoolers were old style, and a change could not be made by gearing, only by adjusting the stud on the lever. This had to be done neatly. The knives or slub catchers were adjusted to their number.

A SPECIFIED GAUGE

for each number was used. A spool of yarn was never so hard but that an impression could be made with the finger so that all friction of the yarn in spooling was reduced to a minimum.

Spoolers on fine numbers were paid by the box, and spoolers on coarse numbers by the spool. The latter seems to be the fairest way to both employer and employe.

The standard length of No. 12 warper was 12,000 yards. The pieces were returned to the spoolers to be filled up. Each spool, therefore, contained 12,000 yards of live yarn. As balance on spool was returned to the spooler, each spool was counted 1.19 pounds, and the price was .0025 cents per spool, therefore, 21 cents per 100 pounds of No. 12.

Warping on coarse sizes was paid for by the pound, the front and tieover girls sharing in the price. For 8 frames there was 1 front and 2 tieover girls. Cost for warping No. 12 yarn was 5.6 cents per 100 pounds, 2.2 cents was paid front girl and 1.7 each tieover girl. Tieover girls are usually paid a fixed price per hour. This method provided an incentive to the tieover girls to do some hustling, and was productive of a large increase of pounds produced per warper.

WARPERS.

There are three makes of warpers—the Draper warper, 18-inch cylinder, measuring roll 18 inches in circumference; worm gear, 100 teeth and change gear, 80 teeth; speed 42 revolutions used in coarse No. 7 to No. 18; score, 4,000 yards. Whiting warper, 18-inch cylinder, measuring roll 15½ inches in circumference, worm gear, 94 teeth; change gear, 81 teeth; used in medium No. 34 to No 60; speed 42 revolutions; score 3,278.2. Holyoke warper, 12-inch cylinder, measuring roll, 10¾ inches in circumference; worm gear, 130 teeth; change gear, 130 teeth; used in fine No. 70 to No. 105; speed, 42 revolutions; score, 5,046. For scores see column 3 in Table 3.

All orders filed in dressing room are in sets of standard lengths. (See column 2 in Table 3.) Each number of yarn was wound on a particular spool. (See column 6 of Table 3), and warped on a beam of a particular flange and hub dimension. (See column 11 of Table 3.) Column 7 of Table 3 gives the average number of ends on section beam. To indicate a basis for determining the number of threads to the number of yarns, column 9 gives the diameter of the yarns. The rule is to multiply the diameter by the width of beam and divide by 16. For example: 66 times 54 equals 3,564 divided by 16 equals 222-7 threads. We get an excellent beam with the threads to the number as above, warped with an inward wind, back raddle set so that each thread will cling to the same side of the wire of front raddle, free working skewers and beam weighted evenly on both sides.

Column 10 of Table 3 gives the breaking strength of each number. Compared with column 7, the fine numbers are apparently under the greater strain. You will note the compensation, column 11, in larger barrels and smaller heads on beams. Column 12, constants, is used as

A MULTIPLE OF THREADS.

Gives pounds by standard section beam. Example: 1-50s, 600 threads, multiplied by 39 equals 234 pounds.

There is kept on file in the dressing room a woven sample of all styles of goods made, on which is pinned a slip or tag containing some such information as shown in Table 8. If more than one beam is needed in the weaving of goods, the percentage of take-up is given on slips, the ground being the basis, say 3 beams, ground being twill weave, a stripe being a plain weave and a leno effect; 100, 132 and 150 per cent would be the relative length of each warp or beam, as shown by column 6 in Table No. 5.

The following tables show the lists of styles and looms assigned:

TABLE NO. 8.
Style 520.

Number of yarn in warp	60	Yards per cut	35.59
Threads in warp	3,594	Slasher gear	32
Number of yarn in filling	60	Cuts on loom beam	28
Picks	84	Loom beams in set	10
Reed	42	Loom speed	150
Harness	4/84	Production per 10 hours	29.8 yds.
Yards per set	9,834.6		

Rule. Loom beams must not contain more yarn than can be woven out in 10 weeks.

TABLE NO. 4.
Loom Assignment of Styles in Fine Numbers.

1	2	3	4	5	6	7	8	9	10	11	12	13	14
Style.	Looms.	Number.	Harness.	Reed.	Threads.	Yards.	Gear.	Number of loom beams.	Cuts on loom beams.	Cuts per set.	Percentage of warps ready for loom.	Beam width.	Warps per day to keep looms going.
1396	159	50/1	4/82	41	3750	55.59	32	9	30	270	32	56	5.28
1396	159	50/1	4/82	41	3750	55.59	32	9	30	270	32	56	5.28
					2588								.5
1343	16	50/1	4/80	40	1392	55.59	32	13	24	294	3	48	.5
1370	46	50/1	4/64	32	1940	65.89	37	8	30	249	9	36	1.4
1389	70	50/1	4/76	38	3268	55.59	32	9	30	270	14	44	2.1
					2548								.5
1398	16	50/1	4/80	40	1424	55.59	32	9	30	270	3	48	.5
					2564								.6
1399	200	50/1	4/80	40	1408	55.59	32	9	30	270	40	48	6.6
1404	400	50/1	4/68	34	2200	55.59	32	9	30	270	80	36	12.
1401	140	60	4/72	36	2234	65.89	27	7	22	149	28	36	4.2
1042	160	60	4/72	36	2234	65.89	27	7	22	149	32	36	4.8
1316	20	70	4/76	38	3256	65.89	27	8	19	149	4	44	.6
1364	20	80	4/90	45	3848	65.89	27	8	19	149	4	44	.6
1391	78	90	4/84	42	3570	55.59	32	9	20	180	16	44	2.3
1394	19	105	4/90	45	3852	55.59	32	9	20	180	4	44	.6

300 Looms.

TABLE NO. 5.
Fancy Loom Assignment.

1	2	3	4	5	6	7	8	9	10	11	12	13
Style.	Number.	Threads.	Pounds.	Reed.	Length proportion.	Yards.	Gears.	Yards in cut.	Cuts on loom beam.	Loom beams in set.	Pieces in set.	Looms.
3971	60	2206	663	42	100%	15,175	33	5,390	28	10	280	120
	34	686	354		110%	16,692						
	60/2	441	264		100%	15,175						
3969	60	2168	651	42	100%	15,175	33	5,390	28	10	280	80
	34	527	318		110%	16,692						
	2/60	592	317		110%	15,175						
3980	90	1352	284	34	105%	15,933	33	5,390	28	10	280	40
	40	1220	546		100%	15,175						
	34/2	47	62		125%	18,969						
3988	60	2168	651	42	100%	15,175	33	5,390	28	10	280	60
	34	527	318		110%	16,692						
	60/2	592	317		100%	15,175						
												300

TABLE NO. 6.
Loom Assignment of Styles in Coarse Numbers.

1	2	3	4	5	6	7	8	9	10	11	12
Style.	Loom beam.	Looms assigned.	Number.	Thread.	Reed.	Gears.	Length.	Cuts on beam.	Beams in set.	Cuts in set.	Surplus warps.
490	48	20	18	2576	$\overset{4}{13.90}$	31-80	64.50	18	15	270	4
565	38	34	17	1194	$\overset{2}{18.18}$	31-80	64.50	16	6	96	7
H.	32	128	12	2228	$\overset{3}{24.00}$	44-79	44.75	15	18	270	25
H.	38	82	12	2228	$\overset{3}{24.00}$	44-79	44.75	15	18	270	16
522	38	32	12	2260	$\overset{4}{12.07}$	29-80	68.75	12	15	180	6
522	40	18	12	2260	$\overset{4}{12.07}$	29-80	68.75	12	15	180	3
266	38	12	12	2244	$\overset{4}{17.07}$	29-80	68.75	12	15	180	2
167	56	16	12	2122	$\overset{2}{20.00}$	45-80	44.25	25	11	275	3
167	66	26	12	2122	$\overset{2}{20.00}$	45-80	44.25	25	11	275	5
499	40	20	12	2709	$\overset{3}{22.00}$	31-80	64.50	10	18	187	4
321	40	20	12	2739	$\overset{3}{22.00}$	31-80	64.50	10	18	187	4
218	38	32	12	2800	$\overset{3}{22.00}$	30-80	66.50	10	18	180	6
218	W. 40	16	12	2800	$\overset{3}{22.00}$	30-80	66.50	10	18	180	5
218	48	40	12	2800	$\overset{3}{22.00}$	30-80	66.50	10	18	180	8
N. 165..	40	50	12	2836	$\overset{4}{18.18}$	30-80	66.50	10	18	180	10
492	W. 40	12	12	3512	$\overset{2}{20.00}$	31-80	64.50	8	23	187	2
201	56	26	12	3510	$\overset{3}{24.00}$	32-80	62.50	12	16	192	5
245	56	58	12	3546	$\overset{3}{21.70}$	32-80	62.50	12	16	192	12
270	56	8	12	3894	$\overset{4}{18.18}$	32-80	62.50	8	24	192	2
317	66	12	12	3954	$\overset{3}{21.91}$	31-79	63.50	8	23	184	2
497	66	34	12	4726	$\overset{2}{20.00}$	31-80	64.50	8	23	184	7
491	60½	6	12	4294	$\overset{2}{20.00}$	31-80	64.50	8	23	184	1
231	40	20	12	2894	$\overset{3}{24.00}$	30-80	66.50	10	18	180	4
556	W. M. 54	6	18	3348	$\overset{2}{17.00}$	31-80	64.50	15	15	270	1
556	56	28	18	3348	$\overset{2}{17.00}$	31-80	64.50	18	15	270	6
		756									

Table 4 is fine lines, Table 5 fancy, and Table 6 coarse. Table 4 is a list of styles in fine numbers. The second column of Table 4 shows the

NUMBER OF LOOMS

assigned to each style. Once a week a report is received from the weave room giving the number of webs of each style on hand and adding to this list the number of webs on the floor in the dressing room. By comparing this list with column 12 of Table 4 we can see just what styles it is best to push forward. Column 12

shows the number of webs that should be on the floor ready for looms. Column 14 shows the number of webs that should be slashed each day. Style 1396 will require a set slashed every two days. When the assignment, as in 1343 or 1398 is small, 2 sets are arranged for as follows: First set, 2 beams of 696 ends, 3 beams are slashed for style 1343, 3 beams for style 1398, by running in 32 ends from spools. The balance of the set is run into style 1399 with 16 ends added. Second set, 4 beams, 637 ends, 3 beams made for style 1398, 3 beams for 1343 by adding 40 ends for spools. Balance of set 16 extra ends in style 1399, as these styles take 2 beams in weaving. This is because there are 2 weave effects of which each will take up differently. The second set will be made of regular standard lengths. The first set will be made in proportion.

Columns 4 and 5 of Table 4 are the harness and reed, 13 being the loom width. The harness on fine side is designated by the multiple of shades in set; 4-80s would be four shades of 20 harness, 20 heddles per inch. From these lists we find how many sets of harness and reeds we need, adding 20 per cent as follows:

Width of loom.	Reed number.	Harness.	Sets.
56	41	4/82	191
48	40	4/80	280
36	32	4/64	55
44	38	4/76	108
36	34	4/68	480
36	36	4/72	360
44	45	4/90	47
44	42	4/84	94

A list is kept of all harness and reeds in stock. Both are examined when returned from loom, and, if necessary, repaired. But sometimes the harness is found to be beyond repair, and it is reported so and orders filed for replacement. On a reassignment, reeds and harness would get first consideration.

Table 5 shows the

FANCY LOOM ASSIGNMENT.

for 300 looms. There is but little difference in providing webs for these looms and in the fine numbers. We make full beams for looms and ground warps would last three months. Leno beams or rolls would have to be replaced many times; about three sets per week would keep these looms running. As wire harness was used for fancy looms, we prepared them as needed. The reeds are the same as in the fine numbers.

Table 6 shows loom assignment of styles in coarse numbers. As these warps lasted about fifteen days, we provided for the weave room according to loom call within the limits of loom assignment.

Table 7 shows the list of styles and webs needed, sent from the weave room each day as follows:

TABLE NO. 7.

Style.	Loom beam.	Webs wanted.	Webs in weave room.	Webs in dressing R.	Webs to make.	Webs made.
490	48	2	1	5		
565	38	3		4		
H.	38	9	25	6		
H.	32	6	5	12		
522	38	2	4		8	
522	40	3		1	2	
266	38	1	1	4		
167	56	2	4			
167	66	2	3	2		
499	40	2	3	4		
321	40	2			2	
218	38	2	2	6		
218	W 40	2			2	
218	48	3	1		2	
N. 165.....	40	3	10	1		
492	W 40	1			1	
201	56	2			2	
245	56	4			2	
270	56		3			
317	66	1	1	4		
497	66	2			2	
491	D. H. 60		4			
231	40	1	7	1		
556	W. M. 54		1	2		
556	56	2	8	3		

Column 5 of Table 7 is filled in from the report of warps on hand prepared by second hand on coarse side at the end of each day. He also prepared list of section beams. The standards for 1-12s were as follows:

276 threads, 329 pounds.
280 threads, 333 pounds.
292 threads, 347 pounds.
300 threads, 357 pounds.

From these standards all sets taking number 12 were made from this list that the overseer made out.

SLASHERS' SLIPS

meeting weave room call as indicated

at column 6 of Table 7. Table 9 shows the method of making out the slashers' slips on coarse numbers.

You will note that this slip contains a list of section beams. The slasher-man, when he puts in his beams in slasher creel, marks opposite each beam on slip the actual weight of beam as found marked on head of beam. The slip will then contain the estimated pounds each beam contains and the actual number of pounds. The total of each list of weights will indicate the variation of the size of yarn.

TABLE NO. 9.
Slip issued to slasher.
Style N.

No. yarn 12.

Threads.	Beams.	Pounds.		
	280		Threads	2,836
	280			
	280		Gear	30-80
	280			
	280		Length	66.50
	280			
	280		Reed	18.18
	292			
	292		Beam	40"
	292			
			No. of slasher..	8
	2,836			

After slashing, the slip is returned to the clerk who makes a record of standard pounds as well as actual. This is then sent to the office. Sets made from 18 or any other number are made only to the set as on fine side.

Harness on coarse side was designated by number of heddles per inch in single shade. The shafts are all colored, there being a special color for number or kinds of harness. The stock of harness is listed and also the reeds.

In the fine numbers, there are in most cases 3 beams from 1 tieover, as shown at Table 3. It has been my experience that it is almost impossible to get a good run out in slasher of set of beams when more than one beam is made from one tieover. The beam that is made from the top of the spool is longer than the beam made from the bottom of the spool. A

SET OF BEAMS

should be made an on the same warper. When warping for looms and more than one style to the same warper is wanted, it is best to warp beams to a uniform number of threads and make a special beam for each set, making up the difference. All beams are made to a standard of threads and length. This is on file in the office, and any new standard is reported and made record of.

When a warper has finished a beam, the warper man takes it off and weighs it and puts on a beam slip, on which is written number of yarn, threads on beam, warper's number and net pounds and style beam is intended for. Warper is paid by the pound and receives credit for pounds' weight.

A list is made out each day of the beams warped, their actual weight and standard weight. This is reported to the main office and to the carding or spinning offices where standards, pound weight of beam and actual pound weight will be compared and variations of size of yarn noted. The warper production is carder and spinner's pound production.

When a set is ready for the slasher a slip is made out as follows:

Beams.	Style 1389. Actual lbs.	No. of yarn, 1/50.	
650		Threads	3268
650			
650		Gear	32
650			
668		Length	55-59
3.268	Slasher No. 2.	Beam	44"

This slip is given to the slasher man, who, on receiving beam, checks it off on slip, the actual pounds opposite each beam. Books of sets are kept by the clerk. Entries are made every morning from slips of all sets made on previous day, and also number of beams in set and aggregate of pounds weight of the whole set of style. All entries are copied on a slip and sent to the main office.

Five slashers are used for fine numbers, consisting of one double cylinder and four air-drying machines, having instead of cylinders air chambers, the yarn being dried with hot air which is kept in circulation by suction fans. This system has much to recommend it, with

SOME DISADVANTAGES;

in drying sheets it leaves the yarn in a condition to open up more freely at dividing rods. As the sheet doubles

upon itself five times, the probability of the sheet sagging at any of the reaches is required to be kept in mind, and to prevent this the operative may weight the yarn too much in front. The lighter the sheet, the greater the difficulty, and as we had some very light sheets to run through even to the single beam, we contracted the sheet, which was the most effectual way to run it.

The slasher then received the various beams for his set and put them in the stands at the back of slasher, latching beam in doubles, using half reed to hold sheet spread to its width when brought up to back of size box. Here latch onto sheet in slasher, double strings being put in between each beam. When this is done, squeeze rolls set down and immersion roll wound down, the machine is started slow speed. As sheet goes through rolls, each string is carefully examined to see that it is all right. When strings reach front, dividing rods are passed through between the strings. This separates each thread in the sheet. Before putting in rods, the loom beam of old set was taken off, the raddle reversed and the rods taken out. The new sheet was worked over to a width evenly distributed. Then the raddle was struck. This is where slasher man shows his greatest kill. The way the sheet is in the raddle has much to do with conditions of loom beam. It is so important that threads be in raddle evenly in fine numbers it is sometimes required that threads be picked in so many per dent. Web was then

CLAMPED TO BEAM

when sheet was raddled to its width. Rules on taping or putting in strings were done to each set of numbers as follows: Number 40, 50, 60, 70 once each beam; number 80, 90 and 105 twice each beam. When beam was full, a reed clamp was put on. The size was in the basement and pumped up and kept in circulation, the overflow returning to supply. The size was made in tanks and run into supply vat.

Five slashers were used for coarse work, these slashers being cylinder slashers. We ran some very large and very small sets from 3 to 18 beams and there was but little difference in the manipulation of the two kinds of slashers.

Table 10 is a series of tabulated sizing formulas for cotton sizing, giving the pounds of ingredients to the 100 gallons. All of these formulas are used in mills of the highest reputation.

Pounds solids, specific gravity, percentage solution and the price have their place in this table.

TABLE NO. 10.
Cotton sizing formulas.

Agents.	Coarse	Fine	Mixes	Colors	Bleached	Grey	Greys	Delicate shades
P. starch	67	95	25	15	50	80	80	50
T. gum			25	15				
Tragasol.						20	40	100
Dextreen	9							
Imperial sizeen		8						
Sugar	15							
Tallow		5.4	2.5	1.5	2.5	5		
Solids, pounds	80	80	45	27	40	61	62	54
Sp. gr.	1080	1080	1045	1027	1040	1061	1062	1054
Per cent solution	8.0	8	4.5	2.7	4	6.1	6.2	6.4
Price	$3.53	$4.37	$3.24	$1.94	$2.97	$4.47	$5.50	$7.83
Caustic soda							29 oz.	
Alum		½ pt.						

I estimate to size 8 pounds of cotton per gallon of solution. Its

SPECIFIC GRAVITY

indicates the added weight to the yarn. Added weight is not always desirable, and if sizing is for weaving only, the less the better when weavable. There are ingredients such as gum tragasol used which has for its principal recommendation this very feature, giving the same results with so much less added weight.

Having a uniform size is of the greatest importance. The overseer sometimes finds that he is not getting it and learns this from the weave room. The slasher and size-maker insist it was the same as before. I would suggest the following method to test size for heft. When you have the size you think is right, measure out five gallons, weigh it and insist that this test is made frequently. It should always weigh the same. It is necessary that it should be the same temperature.

Productions of slasher single cylinders I estimate 4 pounds per minute, allowing 25 per cent of running time for delays. Starch should not be cooked more than 20 minutes after granules break.

Starch should not be cooked more than 20 minutes after granules break.

The Development of the Mercerizing Process

It may not be generally known, but it is a fact that mercerization in its present form is a comparatively recent development. Inasmuch as there are a number of interesting features regarding the development of the process from the earliest times when it was first used, the facts of the development may be highly desirable at this time.

John Mercer, from whom the process derives its name, was a calico printer, and in the pursuit of his occupation, he accidentally discovered that when caustic soda was brought in contact with cotton material there was an extensive shrinkage of the material, both in the warp and filling. When he discovered this fact, numerous experiments showed him that the shrinkage might be somewhat over 20 per cent, and beside this, such material would have a much greater affinity for dyestuffs than if it had not been so treated. Patents were granted for the process, and at a number of times he had satisfactory offers for the use of the process. He refused all offers, however, and never succeeded in getting any rewards for his invention. The

MAIN REASON

for this was because the process as he had patented it, applied only to the shrinkage and not to the results as now obtained. Manufacturers found that the shrinkage made cloth more expensive, and not only this, but it would wear longer with a consequent smaller demand, and they were not enthusiastic about its use. The process was, however, kept in mind by many up-to-date manufacturers, and was used somewhat. One of the large uses before being adapted to present-day methods was in the making of fabrics with a crepe top, or a slightly puffed surface appearance in various patterns. This was accomplished through the use of cotton yarn for the backing of the cloth and worsted or silk for the face. When such a cloth was mercerized, it caused the back of

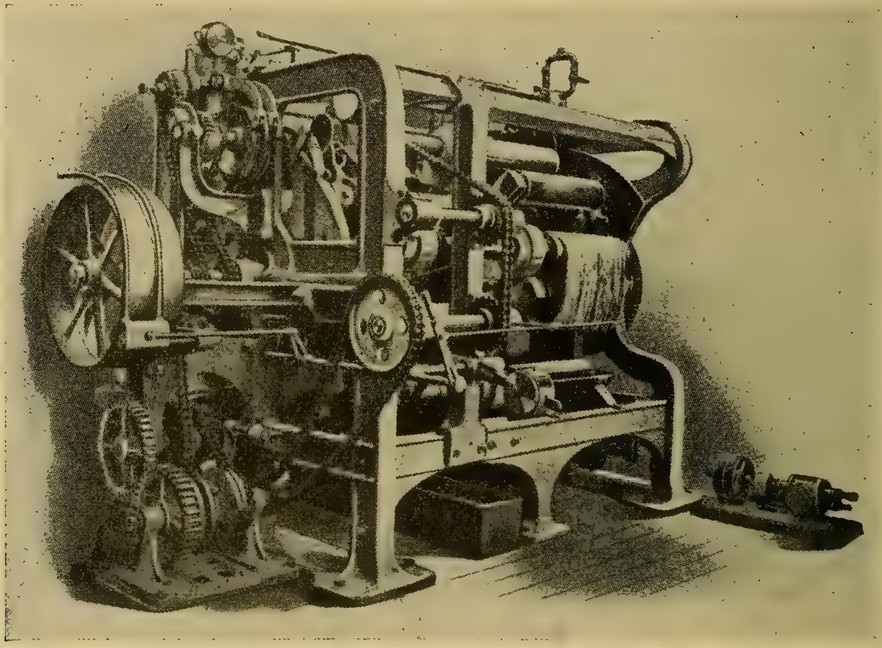
the fabric to shrink up, creating a crepe or bunched effect on the surface. This process is utilized somewhat to-day for similar materials.

LUSTRE FOUND ACCIDENTALLY.

The results of mercerization as noted to-day were obtained in an accidental manner. A dyer who was attempting to produce a level shade on a fabric composed of silk and cotton found that the dyestuffs which he used did not dye the silk and cotton the same colors. Remembering that the process of mercerization made cotton yarn take color faster than under other conditions, he decided to mercerize the cloth to see if the results were not more satisfactory. Knowing that mercerization would shrink the material, and as loss of length was not desired, he mercerized the material under tension and was surprised to find that the result gave a high lustre to the yarn and made the silk and cotton cloth appear very much like a whole silk fabric. From this time is dated the present development of the mercerizing process as to-day noted. Naturally

PATENTS WERE TAKEN OUT

in various countries. In America, H. A. Lowe took out a patent in 1891 and Thomas & Prevost in 1895. It may not be generally known, but it is a fact, nevertheless, that various manufacturers in America used the process because the patents were not believed to be binding. Of course, they kept the facts in the dark regarding the use of the process, as they did not want to pay royalties on the patents. They had various machines built to suit their needs, but did not disclose the fact to other manufacturers. There were a large number of manufacturers who did not use the process, thinking they might have trouble if they did. Litigation was conducted over the situation, but in 1901, or thereabouts, the situation was definitely settled and the patents which had been granted were



Automatic Mercerizing Machine for Skein Yarn.

found to be not binding, and from this time dates the present increased use. It will thus be noted that the large use is of comparatively recent date.

FEATURES OF THE PROCESS.

Continued use has shown very few different results than that noted by Mercer when first patented. The process is used with a solution of about 30 degrees Baume, and at a temperature of 65 degrees Fahrenheit. If a cooler solution is used, say, about 36 degrees Fahrenheit, a solution of about 18 to 20 degrees Baume will produce nearly the same results. The length of time of exposure is not of so large importance as in most chemical processes, ten to fifteen minutes being usually sufficiently long to complete the process. The only necessity is that the goods be thoroughly wetted through. As Mercer discovered at the time, no sizable contraction or mercerization is produced with a solution below ten degrees Baume, although, as stated previously, Mercer knew nothing about the lustrous results. As mercerized goods take up the dyestuffs faster than ordinary cloth, it is customary to use what is called a retarder, so as to give a more level shade in dyeing.

RESULTS TO THE FIBRE.

When cotton fibre is mercerized, it is made rounder and smoother, more like a small glass rod than it is in its original state, and because of this smoother appearance the light rays are reflected instead of being absorbed, and this produces the lustrous effect which is noted on this kind of material. The generally accepted theory regarding the change which takes place is that hydrate of cellulose is formed instead of the pure cellulose, which is in the original fibre, although this fact is by no means absolutely certain. Another feature which is noted, and one which many buyers and sellers of cloth have disputed, is the fact that the yarn or cloth so treated is stronger than it previously was. The amount of extra strength depends somewhat on conditions of operating and the amount of shrinkage allowed, but in all cases there is an added strength, whether buyers believe it or not. The reason why buyers have believed that there is less strength to mercerized cloth has been due to the

CONSTRUCTION OF CLOTH

and yarns used rather than the fact that the process made yarn weaker. As many manufacturers and some buyers know, the more nearly parallel glass rods or cotton fibres or any other materials are, the larger the amount of lustre produced. In order to obtain the greatest amount of lustre possible in the making of mercerized fabrics, it is customary to use a smaller amount of twist per inch in the yarn than for most other kinds of fabrics. If hard twisted yarn be used, very little lustre is produced. This is shown very clearly by the hard twisting of silk yarn. Ordinarily silk yarn, due to its rod-like appearance, has a large amount of lustre, but if it be hard twisted, a large part of the sheen or gloss is destroyed, and the same thing happens to cotton yarn which is to be mercerized. This explains the reason why many of the mercerized cloths are not so strong as those unmercerized. In other words, standards of twist have not been used which give the highest percentages of strength, and of two identical yarns, one mercerized and the other not, the mercerized yarn will have more strength.

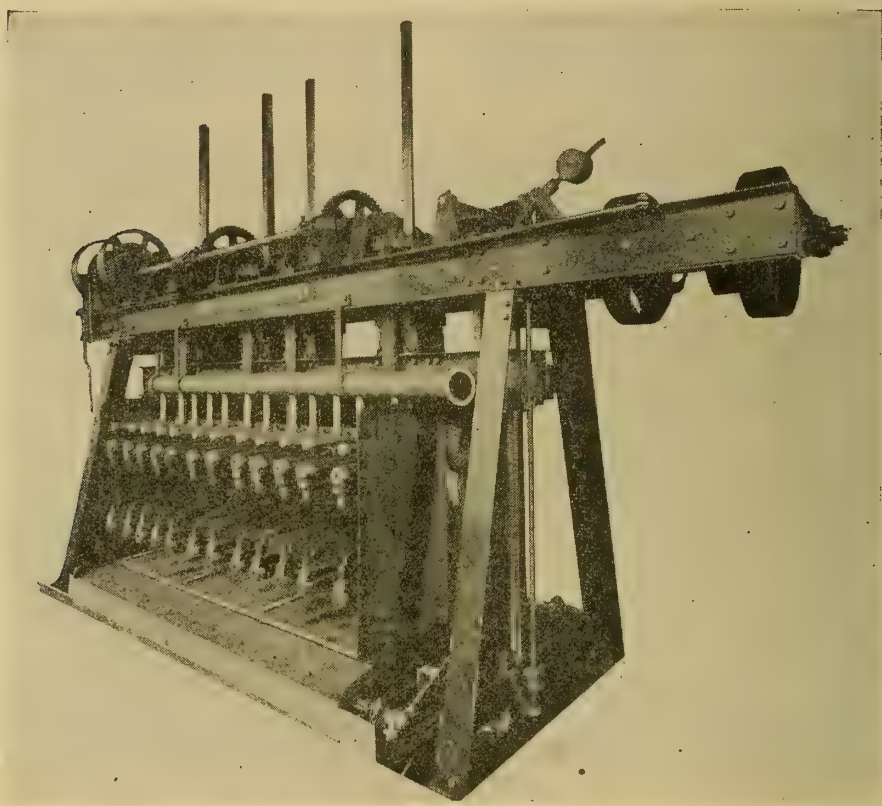
PRESENT-DAY DEVELOPMENTS.

In order to obtain satisfactory weaving yarn, it has been found that the best results are produced through the use of two-ply yarns. That is, if enough twist were inserted in a single yarn to make it satisfactory to handle, the mercerization would not be highly lustrous, while if a small amount of twist were inserted the yarn could not be handled; therefore, in most mercerized yarns two-ply is generally used, with a soft twist. When cloth is mercerized, it is more often the case that single soft twist filling yarn is used. Single filling yarn can be woven with a small enough amount of twist to give satisfactory results, and it is the application of mercerization to yarded goods which is today making one of the greatest develop-

ments in the manufacturing of cotton goods. Five years ago there were very few fabrics being produced which were mercerized, but to-day there are numberless varieties with an ever increasing quantity. Take, for instance, many of the poplin cloths which are being produced. These are made with a soft twist two-ply warp, and are mercerized with the tension placed on the warp yarn, making that lustrous. Take many lines of shirting and waisting fabrics. These are made in various constructions with soft twist single filling and the tension is placed on the cloth width, making the filling lustrous and giving highly desirable results.

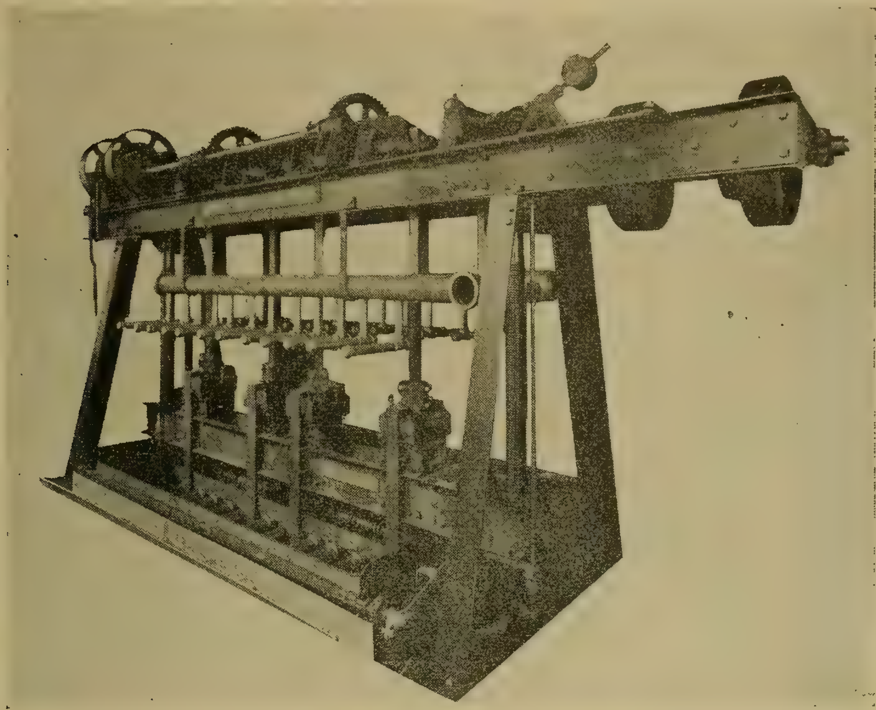
PRINCIPLES OF THE PROCESS.

Yarn is mercerized in the skein form and also in the form of warps, but the only necessity is that the solution be concentrated enough and that tension be applied while the solution is on the material. In mercerizing the skeins it has been found that because of the extra length in some rounds, or the laying of one strand upon another, various strands are not mercerized to the same extent, and this creates, or is liable to create, somewhat uneven dyeing. The process is, however, used quite extensively, but it does not give so satisfactory results as where the yarn is mercerized in a warp form. Practically all of yarn treated in this manner is of two-ply nature. When cloth is mercerized in which soft twist filling is used, the only necessity is that it be held out in width while being treated. This



Skein Mercerizing Machine—Yarn Frame Ready for Loading.

is done in a number of ways, one through the holding of the cloth in a similar manner to that of ordinary tendering machines, while another consists of running the cloth through a solution from one roll to another in a tightly stretched condition, and when wound on the roll, the tightness makes shrinking impossible to only a slight extent.



Skein Mercerizing Machine—Yarn Frame Lowered Into Caustic.

NEW USES.

Most of the people connected with the mercerizing of cloth a comparatively few years ago believed that no satisfactory use could be made of the process excepting for cotton of quite long staple, either Sea Island or Egyptian. The reason for this was because they believed the long fibres allowed a less amount of twist and gave better results, which naturally is true, but the process was more expensive at that time, and the enormous application has made it applicable not only to long staple materials, but also to others of shorter character. To-day, the process is applied to ordinary upland and peeler cottons, in addition to the longer kinds. Recently, fabrics which have been made of yarns no better than those used in ordinary print cloths have been mercerized and the results have been entirely satisfactory, bringing a higher price and making the use of the process justifiable. The cost of mercerizing ranges about one-half a cent a yard, and it is very likely that in the future a large majority of fabrics which are now not mercerized will be mercerized, with a great improvement in the cloth to consumers. Probably no recent development has been of such great importance in the making of beautiful cloth as the increasing use of this process, although, of course, there are other reasons why cloth has improved in the past few years.

USES FOR OTHER MATERIALS.

Few have considered the uses which

are made to-day in cotton cloth finishing of the mercerization process. Many of the beautiful voile fabrics now being produced have been mercerized. Of course, the yarn in these cloths is hard twisted, but there is a partial lustre and a roundness of yarn obtained by this process which makes a better result, and it is used extensively. Then there are many crepe fabrics which are processed in this manner, the shrinkage giving a drape which cannot be obtained in any other way. Other uses are also found for the principle of mercerization. Many of the seersucker effects which are noted in the retail stores are produced in this manner. Most of these effects are stripes, and they are produced by printing stripes on the cloth, and where mercerization takes effect the cloth shrinks, making the non-mercerized portion crinkle up, giving a novel effect which forms a distinct style. Then the principle of mercerizing is also used in the making of two-tone effects. The cloth is printed with the pattern as desired, and where the mercerized portion is when the fabric is dyed the color will be darker, due to the affinity for color, and the other portion of the cloth will be lighter. The increase in use has evolved so rapidly that few have realized it. In the foregoing description, we have given but few of the uses made and only general descriptions of the ones noted. There is no question but that future possibilities will show a still larger likelihood of increase. It is such developments as this which give cloth the variety and the appearance which consumers desire, and which makes the industry a continually progressing one. What the situation means can be stated briefly by saying that it has almost revolutionized the making of shirting and other cloths. Mills which formerly obtained large orders for shirtings now find themselves obtaining few orders and new mills are making many of the new kind of fabrics.

PRICE REDUCTIONS TO FOLLOW.

Another feature which is highly desirable and which ultimately will be more conspicuous than at present will be the reduction in price to consumers. Many fabrics are now being sold in the grey state by mills at anywhere from 7½ to 15 cents a yard and which are retailing at 25 to 50 cents and even more a yard. When competition becomes more strenuous among buyers, prices will naturally be lower. The reason they have not been reduced much up to the present time is because most of the cloth has been used by shirt manufacturers and others who cut up material, and the only sizable portions appearing at retail have been those which have gone through the above sellers and have been sold as an excess of cloth. Soon new lines sold through regular channels will be offered and reductions will be noted. The process of mercerization undoubtedly has been of great value to the textile industry, probably of as large value as anything else, excepting possibly the introduction of colors fast to bleaching, but it can be said that these two processes are more or less bound up together and apply to the same cloths, and together they offer more possibilities than any other one process ever introduced. More will be shown in advancement in the next five years than has yet been noted from these two processes.

Machinery for Print Works

"A line of printing machines an eighth of a mile long." This is the way an official of the Pacific Mills Corporation speaks concerning the size of their new printing plant at Lawrence, Mass. As stated in the American Wool and Cotton Reporter last July, the new Pacific Print Works will centralize all of the printing machines owned by the corporation. The machines of the Cocheco Mill, Dover, New Hampshire, will be combined with those now in Lawrence, and those purchased from the Hamilton Company of Lowell, last summer. At the start, 50 printing machines will be installed in the new mill.

New Printing Plant

The new Pacific Print Works are located near the Wood Worsted Mill. A large new power house has been built. This power house will be fitted out in the most up-to-date manner. Upon the same site, and in connection with the new power plant and print mill, there is to be a new dyehouse.

Specialized Drives

Textile machinery for different kinds of work requires various types of drives. Certain machines which are always operated together can be driven economically in groups. Machines which are in themselves separate units, use individual electric motors to great advantage.

Some special advantages of the modern induction motor have been mentioned frequently in the American Wool and Cotton Reporter. They are admirably suited for operating the majority of textile machinery. Machinery which requires some arrangement for frequently changing its speed does not lend itself readily to the use of induction motors. One point in favor of the induction motor for much of the machinery found in textile mills is the fact that the speed is constant. Induction motors can be made for various speeds, but they are not economical in their use of electricity, and cannot be recommended for mill work.

Printing Machines

Machines for printing cloth require variable speed drives. Some will argue that for this reason the electric transmission of power for printing machines is not advisable. To be sure in textile mills, alternating current motors have many advantages over those operated by direct current. This, in no way proves that it is unwise to drive printing machines by direct current electric motors. This is the question: Which is best and most economical in the long run, individual motor drives with direct current motors, or one of the various mechanical methods?

Printing machines are driven at various speeds according to the grade of the fabric being printed, and according to the pattern which is being applied. If the pattern is a simple one using little color, the machine may be driven much faster than when a complicated design is used. By complicated, we mean one so constructed that a slight displacement of any part of the design will cause the colors to blur. As soon as cloth leaves a printing machine it is passed over hot drums which dry the color. Drying machines are made so that the number of drying drums in use is variable. When all of the drying surfaces are employed it is evident that the cloth cannot be run through the printing machine any faster than it can be dried. In printing upon silk or the better grades of cotton, more care is used than upon cheap fabrics. The machines

printing high-priced materials are generally operated slower than those on the inexpensive lines.

per day when at work upon certain patterns.

Printing machines should be run as

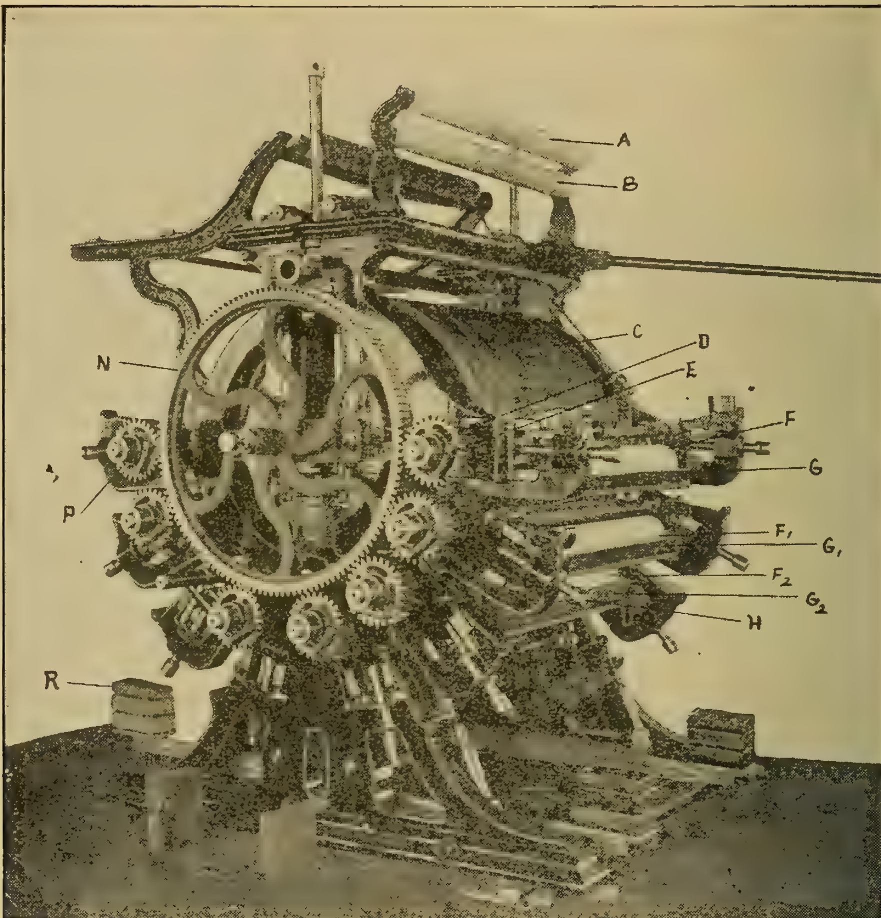


Fig. 35. An Eight-Color Printing Machine.

Production

The amount of cloth which can be printed in a day by one machine varies to an extent which illustrates well the necessity of variable speed drives. The superintendent of a well-known New England printing company states that one machine can at times turn out 50,000 yards of cloth per day. He also adds that the same machine is limited to from 12,000 to 15,000 yards

fast as is possible without sacrificing the quality of the work. If three or four fixed speeds are the only ones available, there may be times when none of them are just suited to the work in question. The greater number of different speeds means that the maximum production is more frequently obtained.

Figure 35 shows a typical eight-color printing machine. The term "eight-color" refers to the number of

colors that it is possible to print at one time. The pattern to be used for a certain "run" of cloth is etched upon copper rollers. There are as many copper rollers used at one time as there are colors in the particular pattern. Three of these copper rollers are shown at F, F1 and F2, Figure 35. To more clearly understand the importance of proper speed regulation for printing machines, we will consider briefly the method of preparing and using the copper rolls.

The designer prepares a small drawing of the design, or if a sample of the printed fabric is at hand, this is turned over to the engraving department. There are two distinct methods of transferring this design to a set of copper rollers. It may be done by the use of a small dye, or pantograph machines may be used in connection with a cut zinc plate. For some patterns, one method is the better and for some the other is considered more economical. We will first outline the manner in which the rolls are prepared with the use of the pantograph arrangement.

Preparing the Rolls

The samples of print goods, or the drawings made by the designer are small. These are put into a special enlarging camera and their enlarged reproduction thrown upon a piece of white paper. The sketch maker marks the general shape and outline of the pattern upon the paper used as the screen. This gives him a rough sketch four or five times as large as the sample. It is a rough drawing, but gives the relative size and position of the various details. The sketch maker takes this sketch to the drawing table and quickly outlines the figures with clean finished lines.

The Camera Room

It must be remembered that only such portions of the pattern that are of the same color are engraved upon the same copper roller. The next step in the process is that of transferring certain parts of the design to zinc plates. We will digress for a moment, however, and explain the object of the pantograph machine. The zinc plate is used with the pantograph machine, and by describing the machine first it is easy to see the reason for using the plate.

As the design to be transferred to the cloth is repeated several times within the width of the fabric, it is clear that the figure must be engraved several times in the space between the two ends of the roll. One object of the pantograph machine is to transfer all of these duplicate figures, along the entire length of the roll, at one operation. By tracing the pantograph pointer over any design the drawing is scratched upon the surface of the copper roller by diamond points. The figure is repeated along the length of the roll as many times as there are diamond points, which depends upon the length of the roll and the character of the design. The pantograph reproduces the figures upon the roll but reduces their size. If the original sample is enlarged four times in the camera room, the pantograph will be set to reduce four times, thus giving the same size to the figure upon the roll as that upon the sample.

Pantograph Machine

It can be seen that it would be impossible for any one to run the pantograph pointer over the drawing several times and each time trace the lines accurately. By cutting the drawing in a zinc plate, it becomes easy to trace the pointer within the grooves. As soon as the enlarged drawing is finished, the figure is engraved upon a zinc plate, but the entire pattern is not engraved upon a single zinc plate, for as many plates are made for one pattern as there are rolls required, and one roll is required for each color used upon the cloth.

Zinc Plates

Supposing, for example, that the pattern is to be printed in two colors, red and pink. All parts of the design which are to be printed red will be cut upon one zinc plate and those which are to be printed pink will be engraved upon another. The first plate will be used upon the pan-

tograph machine for marking the roll to be used for printing the red color, and the second plate will be used for preparing the copper roll which is to print the pink portion.

Object of Enlargement

Any uneven lines or other inaccuracies in the drawing as engraved upon the zinc plate become much less noticeable in the reduced drawing transferred to the copper roll. Enlarging the original design gives a drawing large enough to work upon without trouble. The drawing need not be finished as carefully as it would have to be were the reduction process eliminated.

The figures are repeated around the circumference of the roll, and in doing this the proper spacing must be carefully determined. If but one color and one roll were to be used, the spacing would be important. In such a case, irregular spacing around the circumference of the roll would make the figure appear at unequal intervals upon the cloth. When using several rolls, only a portion of the pattern is printed with each. These various portions must be so spaced that they will properly register and print the complete design. Any irregularity in spacing will cause colors to overlap and blur.

Marking Rolls

As stated, diamond points are used in the pantograph machines for marking the rollers. These points do not cut into the copper to any extent. Rolls are prepared for the pantographs by receiving a coating of special varnish which is not affected by nitric acid. The diamond points remove the varnish and expose fine lines of uncovered copper. After the pantograph marking is completed, the roll is placed in a solution of dilute nitric acid. The acid does not act upon the varnished portion of the roll but etches all parts which have been marked with the diamond points.

Men in charge of the acid etching become so accustomed to the process that they can tell by observation when a roll is finished. The strength of the acid is constantly changing, and it is impossible to give any definite length of time that the rolls should remain in the acid. Rules have been derived, but as the acid is constantly growing weaker, the practical workman will generally depend upon his own judgment.

Wrong Spacing

The other method of preparing rolls is equally interesting, and will be considered later. Imperfect spacing of the design upon the various rollers will cause poor results. In the same way, wrong roller speeds will cause trouble. If each roll is not revolved at the proper speed, the different parts of a pattern will not properly register. Patterns whose parts do not register will leave spaces uncolored where print should appear, and will cause certain colors to overlap and blur. With a set of rolls properly engraved and a printing machine correctly adjusted, it is economy to run cloth through as fast as possible. As stated, the character of the pattern and amount of color determines the proper speed.

The Drive

Various arrangements of belting with different diameter pulleys are used in some printeries. Some drive a group of printing machines by a small direct connected steam engine, and others make use of variable speed electric motors.

Starting

Printing machines should be started gradually and slowly. Shocks caused by sudden applications of power should be avoided. The American Printing Company of Fall River have some machines driven by individual motors, and some operated by pulleys and beltings. The electric drive is giving good results, and it is the company's intention to do away with mechanical drives on all printing machines.

Direct current motors rated at 15-horse power are used. Each printing machine delivers the printed fabric to a set of heated drums, known as the drying machine. At the American

Printing Company, one electric motor is used for operating a printing machine and the drying machine. Both machines are operated together and form one unit well suited for electric drives.

The American Printing Company operate some of their machines from electric motors placed in the room below the printing machinery. The motor is placed upon a platform fastened to the ceiling, and the printing machine is driven by a chain which runs through the floor. The chain drives the shaft upon which the large gear (N, Figure 35) is fastened, and this large gear turns the various copper rolls through small gears. One of the small gears is shown at P, Figure 35.

Electric Motors

There are 97 direct current motors in the different departments of the American Printing Company. Some of the machinery is driven mechanically, but in the near future it is probable that all power will be delivered electrically.

When driving printing machines with direct current motors, the starting box, or controller, is placed near the front of the print machine. This can be done regardless of the motor location.

Power Supply

Direct current is generated by five machines. Four of these are driven by belts from one cross compound engine. Two of the generators are rated at 300 kilowatts each, one at 200 kilowatts and one at 150 kilowatts. This represents a total of 950 kilowatts, which is equivalent to nearly 1,300-horse power. There is also a tandem engine, which is direct connected to a 500-kilowatt machine. Power is delivered mechanically by one cross compound unit and one single cylinder engine. These two engines deliver approximately 750-horse power.

Dyehouse Management

SOME ECONOMIC FEATURES

To manufacture colored goods successfully requires the careful management of a well-equipped coloring department. The problems of this department are many and very intricate. No matter how well laid out or conveniently arranged the dyeing machinery is, or however competent the management may be, it requires the closest application to the study of its daily needs and standard of maintenance in order to keep abreast of the times. In this line of work, different from all others, there is an especially keen competition with which to square up constantly.

Let us consider as briefly as possible, some of the many things which count for success in the organization of the coloring department. In the first place, the location must be at a point where it will be the most convenient to receive the material to be dyed and for the distribution of the same after it is colored. There must also be ample storage space for the grey yarns received and the finished product released.

To enumerate

THE DIFFERENT DEPARTMENTS

of an ordinary dyehouse, they are as follows: 1. Grey yarn storage room. 2. Boiling out. 3. Bleachery. 4. Blue dips. 5. Turkey reds. 6. Blacks. 7. Browns. 8. Fancy colors. 9. Raw stock dyeing all colors. 10. Drying machines. 11. Dyestuffs vault. 12. Laboratory. 13. Drug and mixing rooms. 14. Yarn printing. 15. Overseer's office.

Having the dyehouse quarters well laid out, and with all necessary equipment to proceed with the operations, it is now necessary to have one of the most competent dyers available. This position needs to be filled by a man who not only thoroughly understands his business, but also by one who has a large capacity for details and hard work and is willing to apply himself patiently and with a generous disposition to the intricate daily tasks peculiar to this branch of the trade, and with those with whom he comes into daily contact. In this process, as in all others, the aim is to handle a maximum amount of goods at a low cost and still have the work of exceptionally high grade. Between the start and the finish there is a vast amount of detail to be considered and handled. But, in the main, the quality, production and costs are the chief features which must emerge from the details handled. The quality of the goods dyed depends particularly upon the following

IMPORTANT DETAILS:

1. That the yarns passed through the dyehouse come out unimpaired in strength. Injury to the yarns may occur in several ways. The yarn may be strained by too much tension between rolls at different points; it may be burned as a whole or in spots by the different acids and other chemicals, or it may actually be decayed by passing through too slowly. It may also be worn out in general by too much processing, or it may be worn out in parts by imperfectly faced rolls. There may also be cut yarn caused by protruding obstacles in the vats or rolls. There may also be snarled yarn from careless handling. Snarled and broken yarn can happen a great deal on account of slivers or noils and screws around the yarn cases and trucks. All these should be canvas lined. It may also be stained in various ways.

The colors have a whole catalogue of virtues to be cultivated. They must be fast, match the shade desired, be evenly distributed and lustrous. These are the chief qualities which must be preserved into the lasting or good wearing qualities of the cloth. A color that merely looks well on the surface of the cloth, but without lasting quality, soon becomes as ugly in appearance as an unpainted weather-beaten country barn, or a fast color that is lifeless deadens the patterns. A shade should be bright and make the patterns stand right out.

Any color has remarkably good staying qualities when it has most of the following virtues to its credit: Fastness to light, ironing, rubbing, washing, milling, steaming, boiling soda, alkali, chlorine, boiling acid and perspiration. Of course, not all colors are required to be fast. There are some goods which do not require fast colors, but fugitive colorings are not given unless especially specified. The cost in dyeing is a very interesting study. First, there is the labor cost of handling the yarns and dyestuffs; second, general labor; third, repairs and renewals; fourth, supplies, and fifth, the cost of dyestuffs.

The simplest form of cost finding, of course, is to divide the total number of pounds handled by the total amount of money paid out for everything in connection with the dyeing department, and this will give the general total cost per pound. Going a step further, it is better to divide the costs into the following groups: Labor, general repairs, supplies and dyestuffs. While the first four items may average much the same from week to week, the cost per pound per color may change considerably on account of the rapid improvements being made from time to time by the different dyestuff manufacturers, also on account of changes from one season to another to lighter or darker colors.

But the best method of

COST FINDING

is to have a detailed cost sheet for each color. So great is the difference between certain very dark shades and other very light shades that, unless a very careful cost per pound is kept per color, the true cost of manufacturing particular grades in certain patterns of goods cannot be known, and money may be lost on account of not

having a detailed cost sheet for each color.

There are many other matters which will cause the cost to vary from time to time. Some of these have their inception in the dyehouse, while others may radiate from the office. To enumerate some of these causes, we can state that dyestuffs may vary some, same as the weather, stock to be dyed, the water, temperature, etc., so that if a set of chain yarn is not up to the shade after the usual number of runs through the vats, it has to be run through again, or vice-versa, in case it is over-dyed, it is necessary to strip the shade and then proceed again.

If the depth of color is ordered increased at the office, it will increase the cost. A more expensive quality of dyestuff, of course, will raise the cost. There may be accidents. If a belt breaks, or if a whole line of shafting is bereft of power, it will increase cost, besides spoiling the shade in spots. The variation in size or number ber of the yarn is

ANOTHER CONSIDERATION.

Whenever vats are cleaned out, or there is a general dyehouse scouring, liquors are wasted, and it requires extra labor, both increasing the cost. The dye liquors of standing baths are also lost whenever it is necessary to shift vats to another color. A shortage of yarn, or shortage of running time will increase the costs. The changing of styles from the light shades of the spring season to the heavy shades of the fall season will make a considerable increase in cost. Poor management on the part of the dyeing department, or the office, is another costly item with which to reckon.

Of course, there is every chance to practice great economy in the dyeing department, but it is not always economy to use certain dyestuffs because they are cheap. The goods in any event must be dyed to suit the trade demands, whether they cost much or little.

The following story well illustrates the point:

"Economy is always admirable. A hatter was disgusted the other day with the economical spirit of a visitor to his shop. A tall man with gray hair entered with a soft felt hat.

"Said he, 'How much will it cost to dye this hat to match my hair?"

"'About a dollar,' the hatter answered.

"'I won't pay it', he said. 'I can get my hair dyed to match the hat for a quarter.'"

It makes a difference as to how adroitly everything is handled from start to finish. A competent dyer who is interested in his work, and a close student of the art, can save a great deal of money for his company. In a well-organized dyehouse.

THE DYER

will surround himself with the best of section men available. Each department or section of the dyehouse will be covered by a man who can specialize and is particularly adapted to put the goods through that section. For example, at the bleachery, he will put a good bleacher. He will do the same at the blues and the reds, etc. He will also have a general assistant who goes from point to point, carefully observing each process. In the laboratory, which is a very important department, there will be stationed a competent chemist who will test all incoming dyestuff samples, and keep an accurate record of all details with reference to each sample.

This work is very important, as this service is a check on the laboratory dyeing formula of any particular dyestuff given by the dyestuff manufacturers.

At first it would seem a loss of time and money to make local laboratory tests of any color which the most highly paid expert chemists have already tried out, and given a correct dyeing formula. But this is not so. The fact is that the formula which follows a new brand of dyestuff, when used again under the same conditions as the original directions, gives a result, no doubt, near enough for all practical purposes. However, it is often found that a sample dyeing at the mill, after following the manufacturer's formula, does not give the same result. Here is wherein it pays to

adapt the new formula to the local conditions with a small sample in the local laboratory, rather than take the risk of getting perhaps 1,000 pounds of yarn off shade, if directions are followed without trials. Sometimes it is only a slight change in formula that is necessary to adapt the same to the local conditions. For example, a laboratory test may be made in New York or Europe, where a skein of 20s carded yarn is used.

THE FORMULA USED

is sent to a mill, where 60s combed work is in process. Every practical dyer knows that the same formula used on these two different yarns will also give two different tones of the same color. If the same formula is used on the same number of yarn, one made from nice, clean long stock and the other from cheap, short stock, two shades will be the result again. If the yarns are of same stock and the same number, but there is a great difference in the water of the two dyeings, the results will vary. It can, therefore, be seen that it is wholly a matter of good judgment on the part of the local dyer to adapt the formula to his immediate conditions. It has even been found that while ordinary yarns will take a certain color well, another lot of yarn could not be given the same shade at all. A dyer who is accustomed to using yarn from many sources knows at once just whose yarn will bleach the best, take light blues and pinks the best, etc., and he will select and actually lay out the different makes of yarn with special reference to certain colors best adapted to them.

If one yarn is stronger than another he will lay the stronger yarns aside for Turkey reds, blacks and dark browns, also for such colors that need a bleach bottom. He will take the cleanest and whitest yarn for the bleaching processes.

Taking the breaking strength of the yarns, as received in the gray, and again after having been colored, is a prudent matter. If the dyer is given weak yarn to dye, the same yarn will be weak after dyeing, of course, but if good, strong yarn is weakened in the dyeing processes, it can be daily traced for the good of all. In other terms, the daily testing of yarn strength before and after dyeing is a check and protection for the dyer and all concerned.

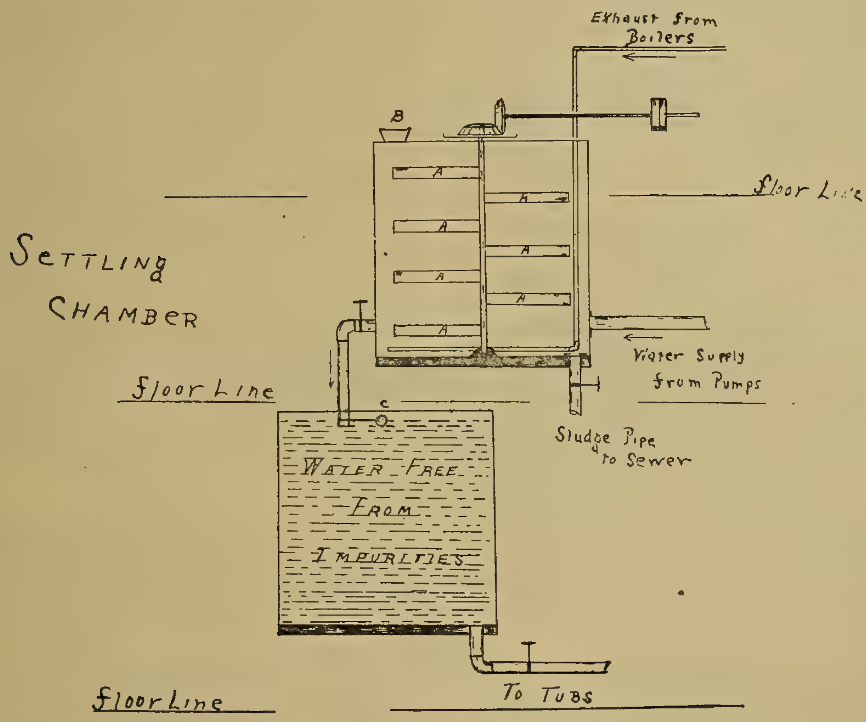
Keeping everything about the dyehouse clean is also a paying undertaking. There should also be plenty of daylight. Passing upon the colors or matching the shades of the newly dyed sets of yarn to the standards is a very particular and interesting work. The dyer will be provided with a set of standard colors. It is preferable to have each color on a bobbin or grill by itself, wound on with a filling motion. This enables the dyer to pull off a little yarn from time to time, to make sure that the original shade is followed. The outside layers may become faded and lead the matching astray. Again, the standards have to be watched. Some colors may fade all the way through the yarn on the grill. So these standard sets have to be freshened with new types occasionally.

Another standard set will be given to the receiver of the yarn who is to put it through the mill. This serves as a double check and is very helpful to the dyer and all concerned. Type sets are also stationed in the office, in the designing room, and other parts of the plant. This lines up everybody who has to do with the colors to stick to the shades wanted all the way through the mill.

Constituents of Sulphur Color Dyeing

Probably in no other branch of the cotton dyeing industry is the same difficulty experienced and the variation of results obtained as in the dyeing of sulphur or sulphide colors, the different methods of dyeing, that is, in the skein, piece, long and short chains, and raw stock, exacting in each instance a thorough knowledge of the ingredients necessary for the matter upon the fibre, perhaps it would be well to enumerate them in the order of their importance: Sulphide of sodium, sodium carbonate, common salt or Glauber's salt, with a reference to caustic soda and turkey red oil.

The economical dyeing of sulphur colors depends first upon the degree of purity contained in the salts em-



Sketch illustrating the principle of softening water where a filtering plant is not installed.
(A) Agitators—Can be revolved in either direction.
(B) Screened receptacle for adding soda ash to water.
(C) Float to automatically cut off supply from settling chamber. Chambers are 12×12×12 feet.

Fig. 1.

procedure to acquire uniform results. As this article is to deal principally with the constituents required for the proper precipitation of the coloring ployed; second, the proper addition of same, and third, the maintaining of a clean-working, standing bath. It might be well at this point to emphasize

the importance of having pure or nearly pure water for all branches of dyeing, since it is the most important requirement and the results obtainable are so often entirely dependent on its condition. By pure water, of course, we mean water that contains the least amount of foreign matter, which, from a textile viewpoint, indicates sulphates and bicarbonates of lime and magnesia or magnesium chloride, together with the presence of iron.

The above, even when contained in moderate quantities, causes a

DISASTROUS LOSS OF SOAPS,

dyestuffs, and other chemicals by precipitating them in the form of insoluble matter. The subject of water analysis covers too large a sphere to be classed under this article, but for ordinary purposes and cases where the water (H_2O) is not too hard, an addition of soda ash is very desirable, say 3 pounds of soda ash to 1,000 gallons of water of 20 degrees hardness, boiling well to allow for a thorough mixture. Allow precipitate to settle for 8 to 9 hours, or over night, when the clear water (H_2O) may be used.

The only method to determine the hardness of water is by chemical analysis, the hardness being expressed by degrees, of which several countries have adopted their own standard, but from a specific viewpoint the English degree comprises 1 grain of calcium carbonate per gallon of water. Generally speaking, no water exceeding

20 TO 25 DEGREES HARDNESS

should be used for dyeing in machines.

In the case of sulphur dyeing, a slight excess of soda ash added to the water is of no consequence. Where a filtering plant can be installed, it is advantageous not only to the dyer and bleacher but to the mill at large.

The water being satisfactory, the ingredients now command our attention, and, as previously listed, we first come to sulphide of sodium (Na_2S), this product being put upon the market in two qualities, that is, crystallized and solid (or concentrated) sodium sulphide, the crystallized brand having 9 molecules of water (Na_2S plus $9H_2O$), which contains in the vicinity of 32 to 33 per cent of pure sodium sulphide.

The concentrated brand is

UNDOUBTEDLY AS FAMILIAR,

being of a greyish black color in irregular lumps. The principal trouble experienced in the use of Na_2S is due to the fact that the salt has been exposed to the air, and being deliquescent in nature, it absorbs carbon dioxide, moisture, and oxygen from the air, partially converting it into a carbonate of soda and sulphate (whitish powder), thus weakening it. This may be averted by keeping the salt in a dry place and well covered, also by not keeping a stock on hand for a considerable length of time.

In dyeing light shades, the dyeing may be very often cloudy or of a dirty tone. This is probably caused by dissolving the sodium sulphide solid and dyestuff together, as in the case of medium and dark shades. Where light shades are to be dyed, it is advisable to dissolve the dye powder in a clear solution of the salt, made by dissolving the solid sulphide in twice its weight of water, and, after allowing sediment to settle, drain off the clear solution to be used. Enough solution can be prepared in this manner for two or three days' work, and the resulting shades are worth the extra labor.

Soda ash (Na_2CO_3), or ammonia soda, the name being derived from its method of manufacture, contains about

98% OF SODIUM CARBONATE.

and is, therefore, approximately pure, aside from traces of common salt, which has no injurious effect. Generally speaking, soda ash, prepared by the Solvay process, or by electrolysis, is sufficiently pure for all branches of dyeing.

Finally, we have sodium chloride, or common salt, as it is familiarly called, obtainable through several sources,—from the rock, sea water and salt water. While it is used in the majority of cases in place of Glauber's salt in sulphur dyeing, ow-

ing to the marked difference in cost, and is satisfactory to the average need, yet in cases where the salt contains some calcium and sodium sulphate or magnesium chloride, which may unwittingly be used in connection with water of no average degree of hardness, the best results are not obtained. In such cases Glauber's salt in crystal form is preferable, chiefly because it contains in the vicinity of 45 per cent of pure anhydrous salt, the balance being water. The desiccated salt may contain impurities, chiefly sulphuric acid (H2SO4).

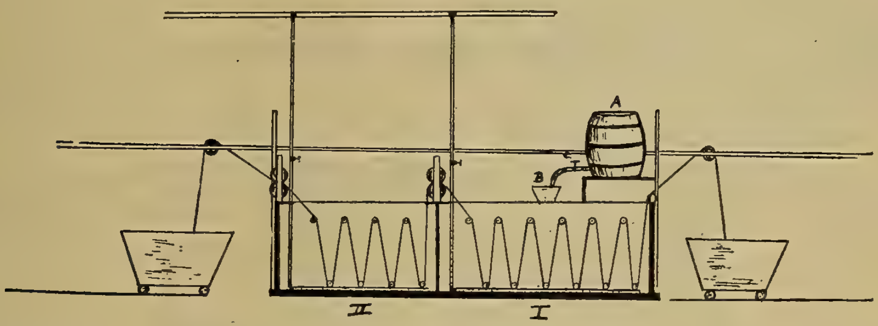
It is a good plan to test all salts for the presence of free acid. When we understand that salts act as leveling agents, it can be readily seen that they should come in for a proper amount of attention.

Aside from the ingredients generally used, a word on sodium hydroxide under treatment, and should be used beneficially on raw cotton and piece goods, in the former about 2 per cent, and in the latter 3 per cent on the weight of goods, adding the oil after the sodium carbonate has been added and the scum removed from the surface of the dye-liquor. Extreme care must be exercised in the use of oil so that the first wash water shall be soft, or the formation of a lime soap will result, which will have a bad effect on the spinning of loose cotton and cause cloudy streaks, which will prove very difficult to remove on piece goods.

Regarding the actual dyeing process for sulphur colors, practice and an application of the foregoing statements will

GIVE THE DESIRED RESULTS,

various dyes having a procedure



(I) Dyebath.
(II) Rinsing bath.
(A) Barrel containing dissolved dye elevated above dyebath.
(B) Perforated trough across tub allowing for a uniform distribution of concentrated dye.
(C) Feed pipe containing shut-off.

Fig. 2.

(NaOH), or caustic soda, and the use of turkey red oil in sulphur dyeing is

ENTITLED TO A PLACE HERE.

In the case of sulphur dyes, which decompose readily, the writer has found that an addition of NaOH is beneficial, and prevents undue subsequent bleeding. Use about one-tenth as much caustic soda as color, and decrease the amount of soda ash accordingly.

The use of Turkey red oil, as would be inferred, is to soften the material adapted solely to their own use, but below are listed a few general hints that have proved practicable and which may be of some assistance in specific cases:

1. Sulphide. Use 1 to 4 per cent, according to oxidizing property of dyebath and grade of material used.

2. Use caustic soda with dyestuffs which decompose readily—about one-tenth the weight of color used.

3. Boil up dyebath first with soda ash, 5 to 10 per cent. Remove skum

and add dyestuff dissolved with necessary amount of sulphide; then add salt.

4. Keep the temperature of dyebath just below the boil for best results.

5. If color comes up too heavy, it may be partially stripped by working in a hot bath with sulphide of sodium.

6. It is economical to use the first rinsing water to boil up succeeding batches of dyestuff or to add to the standing bath, as it contains much coloring matter.

7. In general, keep the specific gravity of standing baths for blacks and heavy shades above 10 degrees Twaddell.

8. Before operating an old standing bath, boil up and test a drop of dyeliquor on filter paper. If color is uniform on both sides of paper, the bath is in good working condition; if not, determine what is lacking, and add necessary amount before proceeding with dyeing.

9. On standing baths a reduction of materials as follows is possible:

	I.	II.	III.
Dyestuff	10%	7 1/0%	5-6%
Soda ash	10%	4-5 %	2-3%
Sulphide	30%	15 %	10-12%
Salt	50%	10-15 %	3-5%

The diagram in Figure 2 illustrates a method of using this type of dyestuff which has proven very successful where uniform results are required, and is especially applicable for light shades.

In Figure 2 no provision is made for saving the rinsing water, for, as in the case of light shades, the rinsing water does not contain enough dye matter to pay for its removal.

Finishing Prints

Machinery for printing upon silk, cotton, or any kind of cloth must be driven by variable speed apparatus.

Print Cloth

Electric motors of the direct current type lend themselves advantageously for this work, but there are several different methods of regulating motor speeds. Each method has its own advantages, and local conditions often determine which type of motor control is best suited for any particular installation. In another issue of the American Wool and Cotton Reporter the different ways of utilizing electric motors for operating printing machines will be explained in detail.

A printing machine stamps the pattern upon the cloth, but there are many other machines needed to prepare cloth for the printing and for finishing the fabric after it leaves the printing machine. Each process introduces certain power requirements. The amount of power needed is not large, but the choice of a proper arrangement is important. Drying machinery, like the printing machinery, must be driven at different rates of speed, according to the grade of the

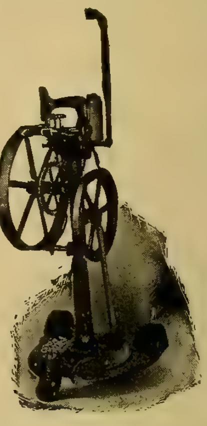


Fig. 50. Foot-power Sewing Machine.

fabric printed and the character of the pattern.

Converters and Owners

Some large cotton mills own their own print works and do their own printing and finishing, while others send their cloth to establishments which do the printing according to the cloth mill's instructions. In the latter case, a cloth mill will send a certain quantity of cloth in its unbleached, or grey, condition to the print works with samples of the pattern they wish used. The print works will prepare copper rolls from the various samples and then print the cloth for so much a yard or according to any contract which may have been decided upon.

Fig. 52. A Set of Shear Blades.

Grey Room

Cloth is received from the cotton mill, and samples and data concerning the amounts desired of each style are submitted to the print works. Work can be started at once upon the copper rolls but the cloth must be prepared and bleached before it is ready for the printing machine. As the cloth is received in its grey condition, the room where it is opened, examined and sewed together, is known as the grey room. If the print works is owned by the cotton mill, the cloth inspection is sometimes carried on in this department. Where the finishing and printing is done by another concern, the cloth is generally inspected at the cloth mill.

Sewing Machinery

Grey cloth will be received at the grey room in lengths varying from 25 to 80 yards. These pieces must first of all be opened up and sewed together. Often no power machinery is used in this process, but power sewing machines are upon the market which are fast coming into more general use. Figure 50 illustrates a type of foot power rotary sewing machine, which is used successfully in many printeries. As indicated, it is a small machine, taking up little room, and can quickly be moved from place to place. The cloth is stretched onto the feed wheel, and is carried through by the machine so as to make an even seam free from wrinkles or puckers. The feed wheel is driven directly from the looper shaft by gearing, so that the relative speed of the feed wheel and the looper shaft always remains the same. It is evident why this relative speed should remain constant. If it did not, stitches would be uneven, and needles would become broken. Belted connections would allow some slippage, but the gearing insures even work.

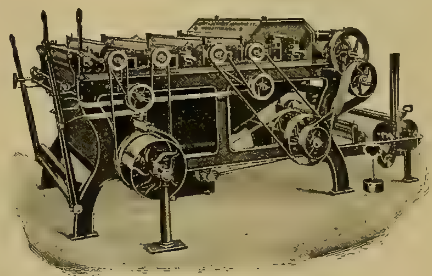


Fig. 51. Shearing Machine.

Removing Nap

From the grey room, the cloth generally passes to the singeing machines. Before the pattern can be printed upon the cloth the face must be made as smooth as possible. If loose threads, nap, fuzz, etc., are not removed before the fabric is fed to the printing machines, the colors will run and blot. Shearing machines are often used for cutting off the heavy fuzz and loose threads, while the fine nap is burned off by the singer. When shearing machines are used, it is common to arrange them in direct connection with the singeing apparatus, so that both operations are performed by practically one machine,

which is made up of a shearer and singer. The machines may be independently arranged so that the cloth enters one directly from the delivery end of the other.

Shearing Machine

Figure 51 represents a shearing machine designed especially for shearing one side of the cotton cloth in printeries. Little power is required to operate these machines, and as the number of shear blades in use with any praticular machine may be altered to suit the kind of cloth running through, this power varies. One set of shear blades is illustrated by Figure 52. The revolver turns close to a fixed steel blade, as indicated by the illustration, and thus cuts off any loose threads or rough places in the fabric. As stated, several sets of shear blades are used at one time, their number depending upon the kind of cloth which is being sheared. Threads, lint, nap, etc., are brushed off by special brushes placed between each set of shear blades. This foreign matter is removed from the machine by a fan and conveyed outside or into a dust room.

Singeing Machine

The shearing machine removes all of the coarse fuzz, but there still remains a fine nap which would prevent good work in the printing machine. The singeing machines burn off this and give the fabric a clean smooth surface which will receive the color from the copper rolls. Singeing machines of various makes differ in details of construction, but there are two general styles of apparatus.

With one type, the cloth is passed rapidly over red hot copper plates or rollers. Contact with the hot metallic surfaces causes the fine nap to take fire, but the cloth moves too quickly for the cloth itself to burn. The other type of singeing machine draws the cloth over two or more rows of gas burners which ignite the nap and smooth the surface sufficiently for printing. Figure 53 illustrates one of the gas singeing machines with four burners.

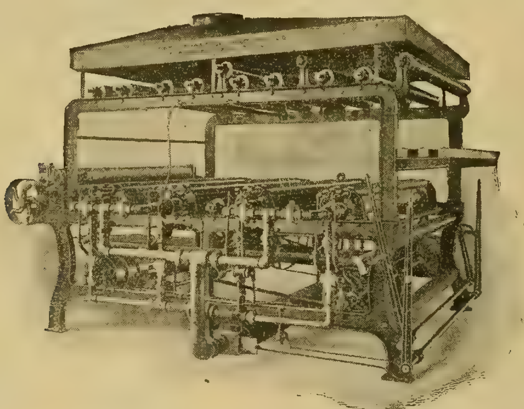


Fig. 53. Singeing Machine.

Gas Burners

The burners on this particular machine have continuous slots their entire length, and thus give a solid and uniform sheet of flame from one edge of the cloth to the other. When the cloth that is being singed is narrower than the machine, the parts of the burners which are not in use may be covered up to prevent any waste of gas. The cloth passes through the flame in

both directions. In passing one way some of the fibres may become pressed into the fabric sufficiently to prevent their removal. When the flame is encountered with the goods traveling in the opposite direction, fibres previously missed will generally be burned off.

Wetting Out

Brass or bronze rolls are used for passing the goods through the flame. These are cooled by circulating water through them, so that the back of the cloth is constantly against a cool surface. If this was not done the rolls would soon become hot and the goods would be burned. After the last burner has been passed, the fabric must be put through a steam bath, wet with water, or run between cold rollers to make sure that all fire is extinguished. If the goods in leaving a singeing machine are rolled, this "wetting out" process becomes of vital importance. One or more fibres may continue to smoulder after leaving the last burner, and if this group of smouldering fibres be wound into the roll a hole may easily be burned through several layers. When this takes place, it is not one yard of cloth that is spoiled, but many. The larger the roll is the greater the circumference, and each layer which is burned represents a waste piece of cloth the length of the circumference. Supposing the cloth is being wound into a roll and a spark burns through five thicknesses of the goods on the roll, if the diameter of the roll is, say, two feet at that particular portion, then the circumference or length of each layer will be approximately six feet. Now, if a hole is burned through five thicknesses, the piece of goods spoiled will be 30 feet long.

A steaming apparatus may be applied to the singeing machines so that the goods will, upon leaving the last burner, pass through a steam bath which will extinguish all fire. If preferred, the fabric may be passed through water, and in some instances, smouldering fibres are put out by passing the cloth between cold steel rolls.

Different Speeds

Like the shearing machines, and in fact nearly all of the machinery used in printeries, the singers must be driven at different speeds, according to the kind of work they are singeing. The speed of the mechanism for moving the cloth can be changed considerably without altering the speed of the main driving belt. This is accomplished in various ways, consistent with the make of the machine. In some cases, a differential friction plate is used, while with other machines two sets of step pulleys are employed.

Gas and air are fed to the gas burners in the proper proportions for obtaining maximum heat with a minimum quantity of gas. As a rule, a small blower is attached to each machine. This by means of an air reservoir insures a steady and constant air supply for mixing with the gas. Burners are designed for city gas or for gasoline gas. The machine illustrated by Figure 53 is equipped with a smoke hood, through which all smoke and odors are conveyed from the room.

The gas flames must be put out before stopping the machine, and with the singeing apparatus, illustrated by Figure 53, it is impossible to shut down the machine without first turning off the gas. The burners are lighted by means of pilot lights, and with the machine shown, the gas cannot be turned on until the machine is started.

Bleaching

Shearing and singeing are done to smooth the cloth for the printing machines, but it must not be forgotten that the goods are still unbleached. The bleaching process will be considered later by itself, and will, therefore, at this time be omitted. Cloth is sometimes sheared after its has been bleached, as well as in the grey, and with some fabrics all the loose fibres can be removed by the singeing machines without using the shearers.

As a rule, cloth which has been bleached would be crocked if run through a singeing machine. It has, however, been found possible to singe

fine finished fabrics without injury. Not long ago, a certain concern had some exceedingly delicate fabrics in the white condition, and wished to remove the nap or fuzz which was on them. A modern singeing machine was tried, and the fabrics were singed in a most satisfactory manner. In ordinary practice, however, singeing is done while the goods are in the grey state. Goods from the singeing room pass through a porcelain or hard rubber ring known as a "pot-eye." This gathers the cloth into a rope form, and in this condition it is bleached.

Printing

Printing has been sometimes termed "localized dyeing." This is an appropriate name for many reasons, but colors for printing have to be mixed differently from dyeing baths. When fabrics are being dyed, the liquor has an opportunity to soak into the cloth, while print coloring must take place almost instantly. For this reason, to produce similar shades a print color will of necessity be much more concentrated than a dye mixture. Color for print work must be thickened, and a color mixer must have a thorough practical knowledge of the various thickening agents. For this work, gums, blood, starches, flour, glue and casein are used.

Attention has already been called to the variance in production obtainable with printing machines. The character of the pattern limits the speed of production in many cases. The length of time that printing machines can be kept upon one style of goods is an important factor governing the production. Considerable time is required to set up a new pattern, and while this is being done, the machine is not turning out goods. Here, again, the nature of the pattern plays a vital part, for with some styles much more care must be used in adjusting the rolls than with others.

Production

Cotton mills operating their own print works plan to run off as much of one style of print as they can possibly use, and in this way, have an advantage over the converter who has to print only the quantity ordered by customers. For example, a converter in printing 1,000 pieces of 50 yards each may receive the order in two lots of 500 pieces each, which means an extra set-up of the printing machine. The party ordering the work may have felt that he could use 1,000 pieces when he placed his first order, but did not wish to take the chance. A mill doing its own printing would generally run the risk of getting rid of the entire 1,000 pieces and would run the whole amount with one setting. For this reason, a converter who is printing goods belonging to someone else is often unable to turn out as many yards per day as the mill operating its own printing plant.

Color Making

In mixing colors, a great many things must be taken into consideration, such as the nature of the dyestuffs to be used, the temperature at which they are dissolved, and the mixing of different colors with one another, as, although, according to theory, two colors may be identically the same so far as class or group is considered, still on mixing together, in practice, under wrong conditions, they may prove that almost every individual color or dyestuff requires handling in a different manner.

TO ILLUSTRATE,

we will take the well-known acid dyestuffs, which are used principally in printing silk or woolen goods. It is very important that each individual

color should be reduced as much as possible before being mixed together, being particular that one should be added to the other slowly, stirring well during the mixing; if these precautions are not taken, it will result in precipitation, and, consequently, "specky" colors. We will take the well-known group of basic colors, which are all "fixed" more or less by tannic acid. Even here we find great care should be taken in dissolving at the right temperature, as some require a "good" heat to dissolve, others require very little, and, in fact, are injured by excessive heat in the solvent used, and the writer believes much bad work which is not generally attributed to this cause is the result of injudicious dissolving.

In large places it is manifestly impossible for the foreman to see every "batch" of color made up, as thousands of gallons a day are made, so this particular part of the color mixing business is allotted to a certain man who has charge of the kettles, and who very often has not got a thorough knowledge or understanding of the importance of the foregoing, his chief concern being to keep up with the demand as to quantity, very often at the expense of quality, bad work in the print room as a rule being put up to the actual mixer of the colors, and not to the kettle man.

It is obvious that in

LARGE PRINT WORKS,

where such an enormous quantity of color is used daily, it would be impossible to make up each particular color as wanted, so stock solutions, or, as they are commonly called, "standards," are made up. Each color is dissolved, a certain number of ounces per gallon according to its solubility. These standards, so far as possible, should be kept in barrels which are as nearly air tight as possible, because, if exposed to the air, a thick crust forms on top, with a corresponding loss of color. In making these standards, great care should be exercised that the solution is not made too strong, for, although it may be possible to dissolve color, say at 12 ounces per gallon, in a hot solvent, the same color probably would not stay in solution at over six ounces to the gallon on being cooled down, dyestuffs varying very much in this particular as in others. This is one of the instances where nothing save practical experience will tell at what strength the various colors will remain in a cold solution, and once color falls out of solution it is useless to try and put it back again, as at the same strength and same conditions it will fall out again. When we have got a well dissolved and cooked standard, we have the foundation of a good working color so far as the printing is concerned.

A color is rarely, if ever, printed at its standard strength, but is reduced, and the mordants added to it until the required depth of shade is produced. In reducing the colors be careful to have the reducing agent as near the same consistency of the standard as possible, as nothing injures the working qualities of a color so much as adding a thin reducer, and, in fact, a thin reducer will not hold the color in solution as well as a thicker one, although there are times when the quality of engraving on the copper rollers calls for a thin color. When this happens, a larger percentage of gum than is usualy used is added, and in some cases all gum should be used, it being possible to

USE A THINNER COLOR

made up from gum than one made up from starch, and water can be added to gum in any quantity, whereas, if added to starch it causes disintegration.

Also, mordants should be added very slowly, for if added quickly they are apt to precipitate the color which not only causes a loss of coloring matter, but also causes bad work in the printing room.

After being well mixed the colors should be strained. This not only re moves all dirt, grit, etc., but helps to mix the color more thoroughly. There are lots of so-called straining machines on the market, but nothing has been invented to equal the human hands, although in case of colors which are injurious to the skin, it is found necessary to use them.

PART IV.

Practical Textile Mill Accounting

Good judgment and a certain amount of experimentation are the first requirements in determining just how far detailed cost records must be carried in order to give the best results. To divide the weekly payroll according to departments and to consider this the expense of each department is a long way from the most satisfactory arrangement. The actual clerical work to be performed by the overseer should be kept as small as possible, but in most cases the overseer should realize that the records he turns in are important and must be correct.

A boss weaver, employed for many years in a well-known New England mill, was asked to explain certain things concerning his production records which he submitted each week to the accounting department. He did not seem overanxious to discuss this question, but finally acknowledged that he and the superintendent generally compared the production data with the figures for the preceding weeks, and then arranged the new figures to

COMPARE FAVORABLY

with previous records.

The overseer was asked if he was not obliged to keep much of his machinery idle for some weeks on account of changes in the styles ordered. 'Yes," he replied, "only last week about one-fifth of our looms were idle the entire time, but if I had sent in such a low production record, I would have expected to lose my job at once." It is needless to comment upon such inexcusable conditions further than to say that similar practice is still being allowed in many establishments, and cost figures are being based upon data of this kind which is much worse than none at all.

This particular overseer was asked if the management would not notice from records received from other departments that his production figures were wrong. His reply was that similar figures had been "fixed up" in the same way before, and whether the management noticed or not he never heard anything from it. This overseer did not seem to realize the seriousness of doing this sort of thing, and said that the superintendent knew all about it and would find fault if he sent in his figures in any different way.

A LARGE SAVING.

A man who is in charge of the cost accounting system in a Massachusetts cotton mill told us the other day that he would guarantee to go into any mill capitalized for $100,000 or more, where no cost system was in use, and bring about a saving of at least $10,000 a year over and above his own salary. To do this, he claims that he would tell the mill agent nothing which he did not already know, and yet at the same time the mill agent would not really know any of the things which he would tell him. This rather contradictory statement was further explained by this accountant in the following way: "To illustrate my point, I will explain to you the way in which a large saving was recently accomplished in our own slasher room. I was talking with the overseer of this department, and asked him casually whether he knew how much the particular kind of yarn that he was using cost per pound. He replied that he did not, but supposed it would probably be worth in the neighborhood of 30 or 35 cents. The yarn in question had been made from a certain special stock which was high in price. It had also been treated in special ways, that it might be suitable for a particular line of fabrics, and by calculating the cost of these different processes roughly in my head, I showed the overseer that the yarn which he was throwing about with none too great care had really cost us some-

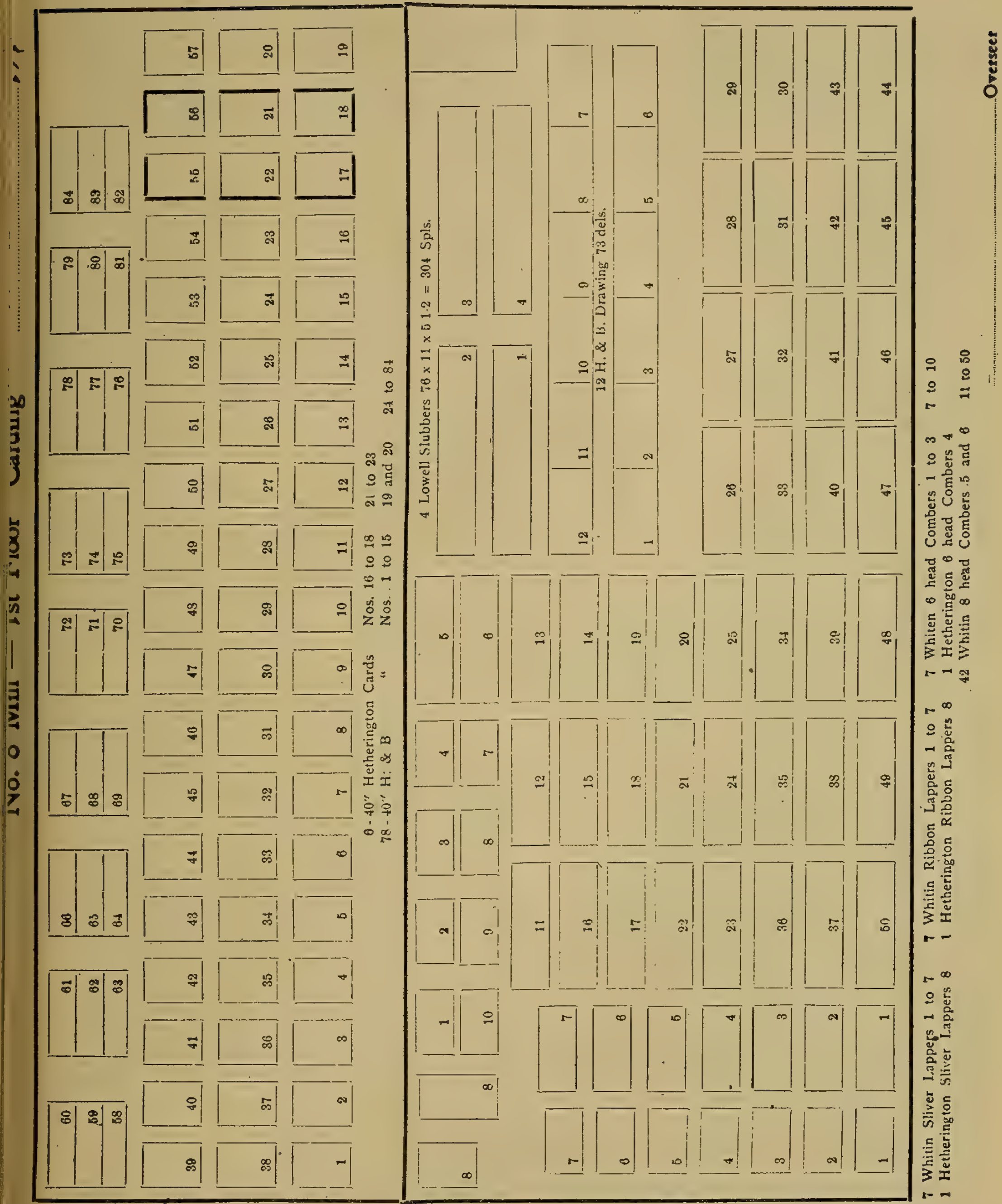


Fig. 1. Daily Overseer's Record Sheet Used in a New England Cotton Mill.

thing like 60 cents a pound. 'I had no idea of this,' exclaimed the overseer, 'but I don't see how it is possible for me to make a bit less waste.'

COST OF YARN.

"I told the overseer frankly that it was none of my business whether he could or could not reduce this waste, and explained to him that I had simply called his attention to the price of the yarn, because I thought that he did not know it. I watched the waste and production records of this department with special care during the next few weeks, and found that the overseer did reduce greatly the amount of waste on all the yarn which he handled. This, then, was a case of showing the mill agent that it was possible to cut down production costs in the slasher room. It is true that I did tell the overseer something that he did not know, but the mill agent was as well informed concerning the cost of yarn as I was myself."

As this cost man put it, there are many points which the mill agent is well informed upon, but which he does not give consideration. Not that the agent is a poor one, but rather that he must of necessity give so much time to other lines of the manufacturing work that these details become neglected.

PRICES BASED ON FACTS.

Without endeavoring to explain the detailed operation of the cost system which is in use at this cotton mill just mentioned, it is interesting to note certain features of it. No price is given to the mill's selling house until their cost man has passed upon it. Again, no new rate of wage is decided upon for any of the mill help without being considered by this same cost man. The records which are kept of all operations make it possible for this mill to determine just how much profit is being made upon any of their many styles. Costs are summarized at the end of each month, and totals entered upon sheets which show at a glance whether lines which are more or less standard are costing the same for each period.

A wide variety of fabrics are manufactured at this mill, and in fact there is one spinning room where it is common for some of the machines to be spinning number 8s yarn and others to be at work on number 80s. This concern manufactures a coarse duck weighing 0.391 pounds per yard, while it also manufactures a silk mull made of a combed warp and silk filling, averaging 26 8-10 yards to the pound. In between these two extremes there are many different weights and varieties which complicate the problems of accounting.

There must be some simple method enabling the overseer of each department to make daily reports, dealing with the class of stock used, the number of machines in operation, the production per day, etc. Unless the returns received from each of the overseers are correct all subsequent calculations based upon these will be valueless, and the time used in making them will be thrown away. Worse than this, any estimates based upon this inaccurate data will lead to erroneous results, and may readily indicate that a fabric is being manufactured at a profit, while in reality the line is being sold at cost or sometimes below cost.

OVERSEERS' REPORTS.

Figures 1 and 2 show two forms used in this mill by the overseers of the card room. Figure 1 is really a diagram showing the approximate location of every machine in one of the carding departments. These machines are all numbered, and the overseer marks, in the space representing each machine, the kind of stock that is being worked. The forms shown by Figure 2 are upon the other side of the same sheet that contains the machinery diagram. In the form headed cards the overseer marks the number of machines that are in operation, the class of stock which is used and the production in pounds per card per day. Under the heading combers the overseer records the numbers of combers running, the class of stock used, the total number of heads and the pounds per set each week. In the drawing frame form there is a column for the number of deliveries in operation, another for the class of stock used and

still another for the pounds per delivery per day. Under the heading slubbers, the overseer states the standard number of hank roving, the actual number of hank roving, the number of spindles running, the class of stock used, whether the twist is regular or not, the pounds per spindle per week, whether the stock is combed or carded and the style number for which the sliver is made. From these sheets the cost department knows just what each machine is at work upon, and yet the operation of filling out these forms is so simple that it requires little of the overseer's time.

In contrast to the production records referred to above where the overseer of weaving "fixed up" his production in accordance with past data it is interesting to note the loom record sheet used in the other mill

No. 8 Mill — 1st Floor

CARDS

Cards Running	Class of Stock	Pounds per Card per Day						
			COMBERS					
Combers Running	Class Stock	Total Heads	Pounds per Sett. per Week					
			DRAWING FRAMES					
Deliveries Running	Class Stock	Pounds per Del. per Day						
			SLUBBERS					
Standard No. Hank Roving	Actual No. Hank Roving	Spindles Running	Class of Stock	Reg. Twist or not	Lbs. per Spl. per Wk	Combed or Carded	For Style	

Fig. 2. Tabulation on Reverse Side of Sheet Shown by Figure 1.

we have described. The blank contains a space for the style number, one for the class of goods being made, one for the number of looms running, a column for the number of looms which are waiting for yarn, another for the number of looms waiting for repairs, one for the number of looms waiting for help and still another for the number of machines waiting to be changed.

In order to properly consider the amount of power taken for each department a tabular form is attached to each of the daily record sheets and contains spaces for the following information: The number of hours run, the kind of power used, that is, whether the power is furnished electrically from the steam turbine, electrically by the water wheels, mechanically by the water wheels, etc. There is also a space for the friction load, the machine load and the total load. In rooms where the same amount of shafting is driven regardless of whether all or part of the machinery is in use, the friction factor is practically constant. The machine load is determined at fairly frequent intervals by measuring the power electrically. A description of this power record makes the matter appear somewhat complicated, but after a few constants have once been obtained, it is easy for the overseer to fill in the two or three spaces giving this power information.

The man in charge of the cost department at this mill was asked whether overseers and other help were opposed to

ADOPTING NEW METHODS

which were made necessary by the installation of his system. He replied that there had been some trouble of this kind, but that he had found it possible to be perfectly frank with all overseers, and had many times urged them to go over various methods of figuring used in determining a fair rate of pay. He stated that in some instances it had been necessary to make changes in the help, but that most of the men had given little trouble of this kind. "To illustrate my method," he continued, "our Boston office recently sent me specifications for a kind of yarn we had never made. I had sample bobbins of this spun, and timed each operation carefully. I then weighed the yarn and obtained a theoretical figure, representing the cost per pound and the amount which could be spun per hour. After allowing certain percentages to take care of the doffing, etc., I sent out a rate of pay for the help on this particular line. The overseer in charge of one of the departments immediately came to me, stating emphatically that to put out this rate in the mill would undoubtedly cause labor trouble. I made the overseer go over most of my calculations with me, and after he had done so he agreed that the price we were willing to pay was not only fair but even more than he would judge was warranted."

It is

NOT ALWAYS POSSIBLE

to explain a thing of this kind to an overseer in a satisfactory way, and the following is an example of how the cost system at this mill detected inaccurate production sheets and in the end made it necessary to discharge one of the overseers. The production sheet from this man's department showed more finished product than he had received from the department preparatory to his process. This was watched for a few days, and it was found that a department receiving the stock from the overseer in question was not getting anywhere near as much as the first overseer claimed to produce. Investigation showed that this partially manufactured stock was not being held up, and it was clearly evident that one of the overseers was reporting an incorrect production, and consequently introducing incorrect data intentionally.

The agent of this mill, and the treasurer as well, admit frankly that their system is still far from perfect. There are still many details which they have not as yet seen fit to consider, but the records which they now have are of great value, and have not introduced unwarranted expenditures of money. On all the different styles it is possible to determine fairly ac-

curately the cost of certain fabrics at any time. From the monthly summaries this information is still more complete, and at the end of five or six months exact summaries can readily be made.

Efficiency Applied to Weave Room

One of the greatest problems before the textile industry to-day is the economical utilization of its labor forces. Our intention is to point out, through a variety of simple examples, the great loss which the whole industry is suffering through inefficiency of conditions arising in every-day life in its various departments. The remedy for this inefficiency lies in the fact that scientific management is far more essential than to hunt up some extraordinary man. Science is proving that there is no limit to the amount of knowledge which the industry can utilize for the benefit of everybody concerned. The search for the more competent men was never more energetic than it is to-day, and the demand for these men is far in excess of the supply.

The mill to-day is divided into departments, each department directed or managed by an overseer, who, in a great many cases, has had no training in executive management. A greater part of the time he is crowded so much that it is next to impossible for him to do his duty, and the mill managers, instead of trying to solve the difficulties and pointing them out to him, often make matters worse by appointing a new overseer.

The principal object of efficient management is

TO BETTER THE CONDITIONS

in the installation of labor in its various classes, not only as a whole but in the development of each man, so that he may be able to do the highest grade of work that his abilities permit. In order to obtain the best possible results, it becomes quite necessary for the employer and the employe to co-operate to such an extent that their mutual relations and interests become practically the same.

Production, as we are now aware, is the most important factor in the industry, as it governs the prices of the finished goods. To obtain this production it is quite essential to maintain a high standard of efficiency, which can only exist when the employe has reached the highest point of attainment, that is, when he is producing his greatest output. To bring this point out more clearly, it would be well to compare two operatives, one having maintained a skillfulness which enables him to produce twice as much as the other, when, consequently, you can pay this workman who has maintained this skillfulness more wages and still increase your profits.

Although this article is intended to deal largely with the efficiency of the various devices used in weaving, we feel that it will greatly benefit our readers by our dealing from time to time with the efficiency of the numerous machines used in the different departments of the mill. We have to-day wonderfully improved machines, directly or indirectly connected with the weaving department, such as the warp-tying, warp-drawing, and the various makes of automatic looms. Therefore, there is no reason why the weave room and, in fact, any department of the mill should not obtain the highest possible standard of efficiency.

A great many of the overseers still believe that if they were to work for their employes at their best possible speed they would be

DOING A GREAT INJURY

to the trade by putting a lot of men

out of work. Yet the development of the textile industry, whether it be the invention of a new machine or the introduction of better methods, which would mean greater production by the workmen and the cheapening of costs, would also mean that instead of doing away with these men, it would actually give them more work. It is readily understood that by reducing the cost, any article which is used in common immediately becomes in greater demand. It is understood that there is great sympathy for men who are overworked, but there is still greater sympathy for the men who are underpaid, and, therefore, in order to deal in efficiency we must ascertain the compensation required to induce these workmen to reach this standard. This may seem a difficult problem, as we must arrange his work so that he can labor most efficiently, no matter how hard the work may appear, and consequently this will mean quite an expense to the mill, but when the results are obtained, it is only a matter of a very short time before you will notice a decided increase of production and an improvement of both men and quality of goods manufactured. This will tend to show that when this standard has been reached, the common tendency to "take things easy" will be eliminated to such an extent that each workman will have great pride not only in his work but in the welfare of the concern.

To make a real and permanent progress, it must be

MUTUALLY UNDERSTOOD

between the employer and the workman that when the latter's standard is being set it does not mean that the price is likely to be cut down as a result of his working harder and increasing the production, as is the case in a great many mills. This only results in the grim determination of the workman to produce as little as possible and prevent further reductions in wages. The writer will point out a number of these cases which have actually come under his observation in some mills in a later installment of this article.

As we stated before that this article was to deal largely with the efficiency in the weaving department, we feel that our next step must be in the arrangement of the looms, so that the weavers may, with the least possible exertion, save time and energy so as to start their looms as soon as possible and ably fulfill as many duties as they can while the looms are in operation. This problem can be easily figured out by taking the average distance a weaver would have to walk and adding the distance of each loom to every other one and dividing the result by the number of looms and multiplying by the number of looms minus one. Where the weaver is obliged to run quite a number of looms it is well for the arrangement to be made

UNDER THE TWO-ALLEY SYSTEM,

and should it be advisable to increase the number of looms 25 per cent, the distance would only be increased 17.5 per cent, showing how much easier it is for a weaver to run the 25 per cent of additional looms than it would be to run an equal number of looms under the single-alley system. Another good point which the two-alley system has over the single-alley system is that it allows the weaver to move in a circular path while performing his numerous operations, whereas, in the latter system, when the weaver has finished a certain number of operations the chances are that the loom needing attention will be at the other end of the set.

A great many mills have enlarged their plants from small beginnings, and have added to them without any definite plan or system to be used in operating them. In some cases, the grade of the work has changed, and a mill which was well equipped for one class of work may be so arranged as to make it almost impossible to efficiently produce a different class. There are also some plants in which the machinery has been so arranged that no consideration of

EFFICIENT MANAGEMENT

was ever thought of. In one plant where the writer has had occasion

to study, the conditions exist to such an extent that the greater part of the machinery in the mill must be re-arranged to make any great headway. For instance, in this particular mill they made some goods which weighed 16 to 22 ounces per yard, and others weighing approximately 5 to 8 yards per pound. The yarns used for the finer grade of goods were spun in one of the mills, which necessitated the carrying of them about 200 yards, and they were handled by about eight men who were inexperienced as to the qualities of the yarn. This made the handling quite rough, which in time caused considerable waste. In the case of the coarser goods, the conditions which existed were exactly opposite.

There are some mill managers who have no idea of doing anything systematically. They may be people of an artistic temperament and have a faculty for continually wanting to change things. Such men are not any great asset to any mill and would probably be more successful as farmers, and therefore, so far as trying to make headway is concerned, it is practically an impossibility. Before introducing the help to the machines we must first study the arrangement, and when we find that the machinery is so placed that the work can be done economically, we will also find that we have solved at least one of the great problems in the industry, as the planning of the machinery has as much effect on the proper operation of a mill as anything the workman can do.

The increased

EFFICIENCY FOR WARP-DRAWING,

or warp-tying, over the old, or hand method, is due largely to the introduction of new machinery. The old method of drawing-in required a considerable length of time, according to the number of ends in the warp and complication of the draw, while to-day, under the improved tying and warp-drawing, these machines have effectively reduced the costs, increased the production and improved the work. It has reduced the cost inasmuch as it requires less labor and supervision, and, consequently, does away with much clerical labor, which had to be maintained under the older and less used method. The production is much larger, owing to the fact that the machines are designed to do the work much more rapidly, particularly in the case of white work. These machines which are used in warp-drawing and warp-tying, at first sight, seem to be quite complicated, but after a little study and closer observation, they become simplified, and can be handled to great advantage by an operative who has a little tact and progressiveness.

When mills purchase new machinery of a somewhat complicated nature, the writer is of the opinion that the mill should try to each, at least two men, the operation of it, and in this way ascertain which one is most capable for the position. By doing this the mill

SETS A STANDARD

upon which it can base the production and the consequent cost of the operation. It is very often the case, where mills install new machinery of this kind, that they have only one man taught the numerous operations of the machine, thinking they can see no material benefit in paying the small necessary charges, but the chances are even whether or not this man can become as skillful as some other workman. If he does not, it means an extra expense of hiring an expert operative from the machine company to teach another man, who may prove as unsuccessful as his predecessor, and in the meanwhile, the poor operative may have been the means of damaging the work of the machine, and costing the mill a considerable sum before the expert operative is called upon to remedy the defects. Therefore, it can readily be seen that the costs will be lower, and a higher standard reached if two or more men are taught the operation while the expert operative from the installation department of the machinery company is installing the machinery. Again, it is

A VERY GOOD POINT

while putting in the machine to have the men who are intended to be given a trial help as much in the erection

as possible, and by so doing they will become familiar with the different parts of it, whereas if the men are not given an opportunity to see the erection it will take a great deal of extra time before they can acquire the speed that they would otherwise have gained by helping in setting up the machine.

It is generally known that the most essential thing in a weave room is to have good warps, in fact, it is impossible to get them too good. It is very often a common sight to see bad warps cut out of a loom. This may be due largely to one or more reasons, such as warps having too much or too little size, crossed threads, and uneven, nubbed or soft yarns. It is generally understood that all machines, sometime or other, will get out of order, and this very often offers or provides an excuse by which an overseer or second hand can crawl out of a difficulty which rightfully belongs to his department. In the case of the knotting machines we often find that the ends will become crossed, consequently making flat places in the warp. This will necessitate either the crossing of the ends from the selvage, or the use of a number of small spools. Now,

ON THE OTHER HAND,

we know it to be an absolute surety that the machine is capable of turning out perfect work, and all the unnecessary work which comes in connection with the cutting of a warp could be eliminated, such as the extra cost of drawing-in, the fixer's time putting in and taking out, the handling of it from one place to another, and the loom girl's time in trying to start it up. Consequently, if we know that this machine will produce perfect work it can be very readily seen that all these faults are due largely to carelessness, and, therefore, should be entirely put up to the overseer or second hand in charge of the department.

Textile Mill Administration

Cost-keeping that counts is not a system which simply shows the cost of operating each department for past periods. It should be possible to tell in advance the manufacturing costs for each yarn or fabric produced. To obtain data suitable for accomplishing this, small details must be considered. Many lines of fabrics must have their cost figured with accuracy. A difference of four or five cents per yard in the selling price may turn a profitable business into an actual loss.

Cost Data

There are certain general records which are almost always kept by mills, and which give an approximation of the fabric cost. To estimate accurately the expense of manufacturing a new fabric, this general data is not sufficient. For a mill manufacturing yarn for its own use, cost figures should be obtained whereby the expense of producing each different kind of yarn and the cost of weaving each different grade may be accurately estimated.

If looms must be used which are designed for wider goods than those being made, this point should receive attention, because the loom is capable of making a wide fabric without receiving more attention from the operatives. If the mill has a few looms which are equipped with all modern automatic devices, the labor expense with these will not be the same as if plain looms were used. With certain lines of goods, it is essential that even slight imperfections be avoided. This means more attention from the operatives and a greater loss of time, due to frequent stoppages. The amount of second quality cloth from an order

of this kind will be much larger in amount than where the requirements for the first quality fabric are not so binding. In manufacturing any fabric, the probable amount of second quality goods must be estimated, and the selling price of the product also carefully figured. In figuring a certain order for cloth, the mill is liable to allow too little for seconds, and find that to fill the whole order it is necessary to start right back at the beginning and make up an additional small lot to meet the requirements. The handling of this extra lot is expensive, and may cut down largely the profit upon the whole order. On the other hand, if too large an estimate is made for seconds, there will be more cloth of the particular grade than the purchaser wishes. Mistakes of this kind will soon cause an accumulation of job-lot goods which must be sold at a sacrifice.

Power Data

The electrically driven mill lends itself to a more accurate determination of power costs for each fabric, and while the cost of power is small, compared with the cost of materials, it is large enough to cause serious mistakes when not included. The agent of a large New England mill has given much attention to cost keeping and cost estimating for all fabrics ever manufactured in his plant. The mill is now largely driven by electric motors, and among other things, he keeps a set of records, showing the location of each motor, its size, the machinery it drives and the location of this machinery. Table No. 1 is a copy of one sheet of this data. In the first column appears the number of the motor which corresponds with a number plate fastened upon the motor itself. In the second column is given the horse power at which the machine is rated by the manufacturer. The third column shows the location of the motor, the first figure representing the mill number, and the second the floor of this mill. In the fourth column, the machinery is located in a similar manner. The fifth, sixth and seventh columns give further information about the motor, and in the next two columns are shown the kind of machinery operated, and the machine numbers corresponding to the number of plates on the machinery.

With data of this kind, it is possible for this agent to determine immediately the number of machines operated by any given motor, the speed of the motor and the kind of machinery which is driven. It is his intention to supplement this information with data, giving the speeds of the counter shafts, size of pulleys, and revolutions per minute of each machine.

Table No. 2 is one page of another classification of motors used by this same concern. This data is arranged by departments, so that by looking up any given department the number of motors, the number of each motor and the rated horse power of each motor can be quickly learned. Our table shows simply the slashing, beaming, winding, spooling, weaving

TABLE 2. CLASSIFICATION OF MOTORS TO OPERATIONS.

Operation.	No. Motors.	No. of Motor.	Rated H.P.	Total H.P.
Slash., beam., etc.	1	16 B	15	
	1	16 A	35	
	1	33 C	35	
	1	15 A	50	
	4			135
Wind. D. spool	1	74 F	15	15
Weaving	1	32 B	15	
	1	73 B	22	
	1	61 B	40	
	1	32 A	50	
	1	51 A	50	
	1	62 A	50	
	1	73 A	50	
	1	61 A	75	
	1	23 A	100	
	9			452
Elevators	1	35 A	20	
	1	83 B	20	
	1	storehouse	20	
	1	76 A	36	
	4			96
Misc.—				
Blacksmith	1	71 C	15	
Machine shop	1	41 A	15	
Hydraulic press.	1	92 C	5	
Pump	1	71 A	7½	
Economizer	1	71 B	7½	
Lighting gen.	1	51 B	35	
Air compressor.	1	11 A	50	
	7			135

TABLE 1. LOCATION OF MOTORS AND MACHINERY.

No. of motor.	Rated H.P.	Location motor.	Location mchy. driven.	Cycles.	Volts.	R. P. M.	Machinery operated.		Machine numbers.
33 A	50	3—3	3—3	60	550	870	5 H. & B. twisters 200×3½	= 1000	1 to 5
							4 Lowell twisters, 84×5	= 336	18 to 21
							9	1336	
33 B	50	3—3	3—3	60	550	870	1 H. & B. twister, 200×3½	= 200	6
							5 Lowell twisters, 224×2½	= 1120	11 to 15
							4 Lowell twisters, 240×2½	= 960	7 to 10
							2 Lowell twisters, 84×5	= 168	16 to 17
							12	2448	6 to 17
33 C	35	3—3	3—3	60	550	870	4 Lowell spoolers, 88×4½	= 352	1 to 8
							1 Lowell beamer, 96"		
							2 Lowell beamers, 46"		
							8 Draper warpers		1 to 8
34 A	15	3—4	3—4	60	550	1,140	18 Draper spoolers, 150×4	= 2700	1 to 36
35 A	20			60	550	1,140	3 and 5 mill elevator		
35 B	50			60	550	870	6 Lowell 1st int., 90×10×5	= 540	36 to 41
							7 Lowell 2d int., 136×8×3½	= 952	5-7 9-12
							1 Lowell 2d int., 120×8×3½	= 120	8
							8 Lowell fine, 144×7×3½	= 1152	29 to 36
36 A	35	3—6	3—6	60	550	870	3 Lowell spinning, 272×2¾×1¾	= 816	66 to 68
							6 Lowell spinning, 240×2¾×1¾	= 1440	60 to 65
							9	2256	
36 B	35	3—6	3—6	60	550	870	6 H. & B. spinning, 228×3¼×2¼	= 1368	
36 C	36	3—6	3—6	60	550	870	6 H. & B. spinning, 228×3¼×2¼	= 1368	7 to 12
36 D	35	3—6	3—6	60	550	870	6 H. & B. spinning, 228×3¼×2¼	= 1368	1 to 6
							27	6360	
41 A	15	4—1	4—1				Machine Shop		
42 A	75	4—2	4—2				49-40" H. & B. cards		85 to 133
							36 Dels Saco drawing		11-15 14-16
							42 Dels Lowell drawing		17 to 24
							78		

and miscellaneous departments, but the data used in the mill includes every department in the plant. Table No. 3 is a summary of table No. 2,

TABLE 3. CLASSIFICATION OF MOTORS TO OPERATIONS. SUMMARY.

Operations	No. Motors.	Rated H.P.	% of Total H.P.
Picking	4	325	7.35
Card rooms	12	595	13.47
Ring spinning	27	1,600	36.22
Mule spinning	7	375	8.49
Spooling	1	15	.34
Twisting	11	675	15.28
Slashing, etc.	4	135	3.05
Winding, etc.	1	15	.34
Weaving	9	452	10.23
Elevators	4	96	2.17
Miscellaneous	7	135	3.06
		4,418	100.00

showing the number of motors in each department, the combined motor ratings and the per cent of the total horse power represented by each of these ratings.

A Necessary Rule

No one in this mill is allowed to change a motor or the size of any pulley without receiving permission from the office. This rule is to make sure that records similar to those illustrated are always kept up-to-date and accurate. Unless this was done, changes would be made in the mill so that machinery would be running at entirely different speeds from those recorded in the cost-keeping records. The inaccuracy of this detail has caused many to go astray. It has not been uncommon for mills to figure production upon certain speeds of machinery, and then after having made several errors find that slight alterations had changed the speed of the machines in question, so that the production figures used were not correct. By absolute accuracy and attention to the small details, much can be accomplished in determining the cost of a fabric in advance, and in determining this correctly.

Overseers

Mistakes, and serious ones, are made by employing poor overseers, second hands, master mechanics, etc. The office of superintendent is likewise frequently filled by a man unfamiliar with the manufacturing details peculiar to making cotton, woolen or worsted goods, as the case may be.

Overseers and some superintendents will exaggerate the importance of the practical mill education, crying down the theoretical man at every turn. If the manager of a mill is a self-made man who has grown to his position from a bobbin boy, he is dangerously apt to disregard the advantages of general training, taking the stand that the man who has been in the mill since the age of fourteen or fifteen years is the one best suited for the position. The conditions are different than they were when this manager started on his own career, and he should give this fact its due consideration. If the manager's position has passed from father to son, and from son to nephew or cousin, the relative in charge after two or three hand-downs may lack both theoretical and practical knowledge of the business. When this is true, important mill positions are generally held either by personal friends or by so-called practical men who have spent much time in the mill, but who have gained so little practical information that they are obliged to work cheap. The low salary demanded may appeal to the employer, but does it pay in the end?

It has been said recently that clerical work of all kinds should be taken away from the mill overseer and performed in the main office by a clerical force employed especially for this class of work. It is further argued that the overseer is familiar with the various operations of his department, and that all his time should be used in watching the operatives and in keeping his machinery in proper adjustment and condition. The office force, it is claimed, are in a better position to handle all records, and should from past data be able to notify the overseer in advance just what production is required, and then hold him to it. This same idea is carried still further

to the superintendent, and he is said to be of more value if he is continually in the mill checking up the work of his overseers.

Insufficient Data

There is much true logic to this, but there is danger of carrying the matter to extremes and doing more harm than good. The idea is along the line of scientific management which under proper guidance has shown wonderful results. But the one trouble is that scientific management ideas of this kind are tried by men who have insufficient data upon which to make estimates, and men are put in charge of the clerical end who cannot handle the proposition satisfactorily. The uproar for scientific management is all right in itself, but concerns which are endeavoring to institute radical changes under the supervision of comparatively untrained men are making a mistake.

If a good overseer feels that he is being handled simply as a machine his resignation will be received within a short time. He should always be on his guard to prevent operatives from slighting their work, but unless he is consulted and given a chance to make suggestions, much of the man's value is lost. He should keep certain records, although some overseers have too much of this work to do. The man who is always on the spot and who is familiar with the kinks of the business can frequently introduce valuable changes.

In commenting upon certain cost finding data, an overseer recently remarked that the scheme was good enough, but had too much red tape and would use up too much time. Here, then, is one excuse for the belief that all clerical work should be done in the office. Is the overseer who made the above remark the type of man who is in line for a superintendent's position? We think not. If the mill management handles overseers properly the right kind of man will be capable of grasping the importance of recording valuable data which they are in a position to obtain every day, and by their co-operation the cost of production will be cut down and the quality of goods improved.

Co-operation Essential

The superintendent should make it a part of his work to visit every overseer as early as possible in the morning. At this time, he should give overseers the opportunity to make suggestions and should consult with them in a manner which will make them feel their own importance and responsibility. At this time he should also notice the way in which the work is running, and should call for explanations concerning anything which does not seem up to scratch. In his personal interviews with the overseers, he must become familiar with various changes which are deemed advisable by his men. These matters should receive his own personal attention and after being studied into should be taken up with the management for their consideration.

In certain mills, overseers have the idea that they do not receive credit for suggestions they may make, and for this reason, good points are neglected. It is true that something is radically wrong where this kind of feeling exists, but the class of men who hold these positions are quite ready to accept this attitude, and many times, it is forced upon them, due to the lack of tact which could be readily employed by the management.

A Well-Managed Plant

One well-known cotton mill which is to employ a new superintendent has divided the work between two men with the explicit understanding that the position of general superintendent is to fall to whichever one of them shows best results. They have both been advised that this does not mean that they are to work independently in an endeavor to outdo each other, but that they are to pull together with the understanding that one of them will be advanced to superintendent of the whole mill. This plant is a rather large one, so that two good men will probably be required, but the way the whole proposition has been outlined to

them shows that the management wish co-operation along every line and are willing to aid the help in this respect as much as possible. The treasurer of this mill is a practical man, but also one well informed along the theoretical side, and is treasurer of one or two other large concerns. The agent of the particular mill in question has had valuable experience in the selling end as well as manufacturing, and the concern bids fair to be one of the most successful in this part of the country.

Came to Grief

A certain woolen mill which was using considerable carbonized wool changed superintendents. The new man found that the wool had been passed through an extra scouring process. This scouring seemed unnecessary to the new superintendent, and orders were given to discontinue it. The carder immediately came to grief by finding it almost impossible to handle the stock in his machines. It clung to the cards, became matted and gave all kinds of trouble. The former superintendent was consulted, and it was learned that the extra washing had been carried on to remove a certain amount of white powdery substance which was present in the carbonized stock which they used. The management of this mill had been well aware of the reason for removing this foreign matter, and had the proper cooperation existed between the new man and the manager, the necessity of calling upon the former superintendent would have been eliminated.

To obtain a thorough knowledge of the manufacturing processes, it is necessary to spend considerable time in a mill under actual operating conditions, but the man who has had a training along certain general lines will pick up much more from his mill work than the man who has been unable to obtain this. In a paper entitled "Textile Education From a Manufacturer's Standpoint," read by Edwin H. Marble at the last meeting of the National Association of Cotton Manufacturers, the following statements were made:

"An official of one of the larger woolen companies operating seven different mills told the writer that the best returns they had received for money expended resulted from taking a good carder away from his mill position and sending him from mill to mill, spending such time as was necessary with each overseer, and endeavoring to instruct them in the handling of their respective rooms and also aid them in solving the problems that from day to day are brought to their attention. Not a correspondence course, not a regular apprenticeship, but a personal instruction in card room methods.

The Practical Side

"The student must himself master the situation, and can only do this by a long enough manipulation of the fibre, or working of the machine in order to become familiar with its particular operation. While it is possible to obtain many textile machines very nearly human in their automatic action, yet each one has some peculiarity that must be mastered by the operator, and such mastery is a necessity before the master workman is allowed such title. Again, many processes through which the fibre or fabric must pass demand skill that can only be acquired by failing to do rather than by doing the right thing. It is through making mistakes and then learning how not to make them that one gains the greatest confidence in himself.

"While we would lay a good deal of emphasis upon the manipulative element in the training of the master worker, this should be secondary to the thorough understanding of the principles involved and the application of the theories controlling the industry."

A Cost-Finding Symposium

ABOUT OMITTING THE OVERSEER.

In his recent address upon "Mill Accounting," before the American Association of Woolen and Worsted Manufacturers, Mr. F. Gordon Patterson argued that accounting should all be done in the office and not in the mill. He said among other things: "I have known overseers to devote more than a quarter of their time to this work.

"This is all wrong and expensive. Oftentimes a bright boy or girl in the office can do the work in a fraction of the time it takes for the overseer to do it, with his wealth of knowledge regarding his manufacturing processes, but who lacks

THE ADVANTAGES OF SCHOOL.

"One object in drawing attention to the fact that overseers are doing this work, for which they often are not equipped, and that is expensive, is to recommend that it be done in the office. Clerks in the mills are sometimes necessary, but it is not to be recommended if the work can be done in the office. One clerk in the office is worth two or more in the mill, for he is available for a greater variety of work, he is generally of a better type, he has the incentive of seeing how other clerks do their work, and if there is the proper discipline and incentive in the office, he will endeavor to improve his work.

"All this naturally raises the question of what you are going to do with the clerical work in the mill.

"Arrange the information as it is collected, or as the original entry is made, in such a manner that it can go direct to the office and then be analyzed for the pay roll, reports, etc.

ELIMINATE THE PAY ROLL.

"To illustrate this, I would eliminate entirely the time-honored pay roll kept in the several rooms, and substitute service cards. These service cards show the man's name and number, the kind of work he was doing, and the order number or class of product on which he was working, the time he worked on each job, and the quantity of work he accomplished. These cards should be collected by the overseer and be approved before being forwarded to the pay clerk. The pay clerk, when posting the time to the pay roll enters the rate on the service tickets and those are then analyzed for costing purposes.

"For piece work, premium work, etc., a card somewhat similar to the other may be used, although it is quite usual to use coupon tickets similar to the weaver's cut coupons many of you use, but containing a little more information. These make a convenient form for general office use, as they may be rapidly sorted to men's numbers, and after being posted to the pay roll, they may be again sorted, as desired, and the totals rapidly drawn off on adding machines.

HORRIBLE PUNCH SUGGESTION.

"It is also of common occurrence to use some form in connection with a conductor's punch.

"The information on these service cards can also be used for supplying data as to the progress of work through the mills, and as to the quantity of work performed for posting to the order register.

"An order register may be made of very great assistance, if arranged to provide information as to the condition of each order, the date required, finished, shipped, etc. The entries may be made by checking from the service cards of men performing particular operations. By this method, it is possible to keep watch of each order, and when time of delivery of sample pieces is specified, this is a matter of much importance.

"I believe it is better policy to compile this information regarding pro-

duction and costs in the office, and to tell the overseers what they have done during the past week or month, rather than to depend on the information they can provide."

WHAT AN OVERSEER REPLIES.

To the above suggestions, an overseer of broad experience replies as follows:

Although agreeing with the speaker as to the needs of a system of mill accounting in textile corporations, we do not think he has suggested a method that will meet all conditions, in fact, he seems to have completely overlooked the value of statistics to the overseers in their several departments.

We have passed that period when labor was extracted from workers by the application of the whip or any kind of coercion. To-day, workers must be treated as intelligent beings, and the overseer must have an understanding of the production value of labor, the production value of each machine in his department, in addition to a familiar knowledge of the process of which he has charge to enable him to govern his help; in other words, scientific methods must be used in the department detail as in general mill administration.

OVERSEER MUST BE RESPECTED.

With department statistics before him, the overseer is in the position to note those who lag behind in their work, and to urge them to a better effort, and when the operators protest that they are doing as well as their neighbor, the overseer has the figures to show, and these are sufficient. The overseer who is in a position to meet conditions in this manner stands strong with his help, and controversies of this kind are few, and an appeal to their personal pride will almost always produce the desired results, and at no time need there be any hard words, but the kindliest feeling prevalent throughout the department.

Without data, the dominating idea with the overseer is to keep after the help, and the demeaning practice of standing over help and watching their every movement not only develops resentfulness and a loss of self-respect on the part of the latter, but also on the part of the overseer. This feature has done more to drive the native-born Americans out of the mills than any other. Our whole system of education inculcates individual independence, and immediately we put the people to work we proceed to strip them of all self-respect, destroying individual initiative—a quality which is peculiarly American—making out of the young person a cowardly little snuffling brat who has no joy in his work, but continual fear that he will have the boss nagging him.

SOME COUNTER QUESTIONS.

The assumption of the speaker that the average overseer lacks schooling and the statement that the statistics of his room could be better handled by a bright boy can only be understood in the light of the speaker's need of an excuse to introduce such a complicated method of securing statistics, but we would point out to him a seemingly slight inconsistency, namely, if the overseer who invariably has been a common workman and promoted for merit lacks schooling, how is the average worker who also lacks schooling going to make an accurate record on service cards even if they are in the simplest form as he suggests.

We are afraid that the speaker lacks experience among the overseers. The making up of his production sheet is a much desired opportunity which the overseer wants to make comparisons and see where he stands relative to the production of the preceding weeks, cost and pounds cost. In surveying his pay roll, he notes the earning of each individual piece-worker, and also realizes the cost of day help. It is on those occasions that the overseer gets a jolt when he sees that, comparatively speaking, his waste percentage and his pounds cost have gone up and the earnings of the help have gone down, and he immediately proceeds to look over the detail of reports and quickly locates the trouble. How would this be done without statistics?

BETTER ACCOUNTING METHODS.

The relief he offers to the overseer

is of no value, because all service cards will have to be passed by him anyway, and will entail a good deal of labor to verify. In addition to this, the discipline of his department will be considerably impaired, as in the making of records each worker will have an excuse to refer to each other any features in making records that they think they do not understand. This feature in dealing with help is well understood by overseers, and every excuse that help have to get together is promptly eliminated when found by the overseer.

By making a survey of the activities in mills the reader will find far better methods in mill accounting than the speaker has to offer, and it is the intention of the American Wool and Cotton Reporter to continue its crusade in this direction, and it expects to see the day when standards of value in the mills will be so accurate that efficiency in the administration of mills will receive corresponding returns in profits and the parasite of inaccuracy will be banished from the textile industry. MILLMAN.

Cost-Finding Suggestions

During the past year there has been a constant thrashing out of the tariff as it is now administered. The various schedules have been called the root of all that is bad in manufacturing and commercial relations in the United States, and that they have permitted enormous profits to a few, by many who are advocating either lower duties or no duties at all depending on the stand which they assume on the question. Manufacturers are just as emphatic in their protest against any revision to a lower figure, claiming that if changes are made it will compel them to retire from business operations. Some manufacturers even go so far as to claim that certain duties should be made higher than they are at present, for the duties are not fair in some cases.

IT SHOULD BE ADMITTED

by any person intimate with conditions that affairs as they exist to-day are no fair basis on which to make any estimate of profit or sales, because mills have been compelled to curtail production for the lack of orders, and costs of operations have been much higher than usual, as mills have had to operate with much machinery standing idle; and not only this, but prices have been forced to low levels by the competition for orders. Added to these conditions is the fact that cotton has gone from high to low levels, and the resulting uncertainty in stable prices has made an unusual situation, and one from which no fair comparisons can be drawn.

It is a fact that many manufacturing plants in the textile line are undercapitalized, but do many admit that this extra valuation is brought about from the large earnings which were previously possible?

The dividends which have been paid out in the past, whether large or small, as the case may be, do not represent the earnings of most corporations. This is a fact, and can be seen from investigation. Many mill men, however, admit there is a large variation in the tariff duties, as now assessed, and it is certain that some grades of cloths are more highly protected than others through the insertion of jokers, as they are called, or through the variableness in the manner of assessing duties. There are some mill men, although few in number, who think the present duties are wrongly or highly assessed, and among these, perhaps, Walter Langshaw is the one who is the best known. In the operation of his mills

and in the profits secured he has been notably successful of late, and because of his stand on the tariff he has been criticized by many manufacturers.

While manufacturers in general have had numerous opportunities to give information regarding the cost of manufacturing various fabrics, and also other details in connection with manufacturing, they have always been

MORE OR LESS AVERSE

to supplying this information. This is one reason why people in general doubt many of their statements regarding manufacturing conditions, Mr. Langshaw with others, while not believing in the present tariff, and admitting it is not fair, even if duties are added to their present percentage, has not offered a solution of the difficulty. We do not blame him or the other mill men, excepting that in so far as their business in the future is concerned, it would be better to have the situation settled right, so that a fair degree of certainty could be assured to a manufacturer, and he could adapt himself to future settled conditions. Successful mill men are busy men, for they have their immediate duties to transact, and, contrary to the belief of many, these duties in many cases require keen judgment, and because they have not offered a solution we are going to suggest a possible remedy.

LABOR CHARGES IDENTICAL.

The reason why we say there can be no fair tariff under present methods is because, for one reason, the duty is placed not only on the labor item, which is included in the making of a piece of cloth, but also on the material of which it is composed. Just consider what the American people are paying for, and it can be seen that they are paying duties on material, which, in cotton goods at least, in many cases, they have exported in the raw state. Another fact in this connection is that the material cost may vary in two pieces of cloth but the labor charges be identical; that is, one cloth may cost nine cents to produce, and another ten cents to manufacture, while the labor to produce both samples was identical. How is this difference to be recognized under present methods? It manifestly can not, and the cheaper cloth will not be as highly protected as the more expensive fabric. This above statement holds true in most cloths, for even if the construction of the fabric is identical, manufacturers vary the staple to a degree, and although cloth prices vary, the labor cost of manufacture may be the same, and this creates a wrong protective duty.

ANOTHER ILLUSTRATION

of the variation can be given as the duties are assessed at present. Two cloths may have the same price, one may be a high count in the filling, with the yarns of rather fine size, and the other may have a coarser count in the filling, with a heavier size yarn, say one cloth is made with a soiesette construction and the other with a poplin construction. One cloth will have the value made up of a much larger percentage of material than the other, and the larger charges will be widely variable. In some cases, the labor may be twice as much in one cloth as in the other. It is absurd to believe that a fair duty can be assessed on cloth when these conditions exist to a greater or less degree in every piece of cloth manufactured. There are also other variations in duty, due to the excessive additions on some grades, which are not enjoyed on other varieties, but we have not considered these, for they are in some cases deliberate plans to protect some special interests.

We have considered the question in its best aspect, and we firmly believe that no satisfactory arrangement can ever be made when such a system is employed. Any planning of duties by the present tariff commission will develop the same faults which are shown at present, and if duties are lowered, the same variation will be evident, for it is absolutely impossible to eliminate them. To settle a question which means so much to the industry, it should be considered by men who are intimate with mills and mill conditions, and who are not

interested enough financially to bias their opinion. As we have previously stated that the present method is fundamentally wrong, it is necessary for us in maintaining our position to give at least a general idea of what we should consider the correct course. A method could not be correct in every detail at first, but in handling the subject, it appears from our observations that a better method would be one that was based on the labor cost, which is included in the making of a piece of cloth. Many will claim that this cannot be done; but we ask in seriousness whether it cannot be done. It would require a small force of experts, but it would be far more accurate than at present; in fact, we believe it would, in some cases, be exact, so far as all practical purposes go. The labor cost of making various sizes and qualities of yarn could be obtained quite easily, the labor which is employed in the various operations of manufacturing, in fact, the total labor cost could be obtained.

THROUGH MANY COMPARISONS

it has been found out that the extra labor charges in America may be in the vicinity of 50 per cent higher than abroad, and although this may not be correct, we have assumed that it is. If this duty be added to the labor cost alone, and a sufficient percentage be added, because of the higher cost of building materials and supplies in this country, will not this represent far more accurately than at present the correct duty? Of course there are some other items which may vary this amount, but these could be easily obtained, and it seems sure that the widest variation in this method would not be one-tenth the variation at present under ideal conditions of operation, which we never expect to see.

By this method of figuring, it will be seen that one of the largest variable items of cost has been eliminated, namely, the material; and as this item will vary so widely and will affect the price of cloth so largely, it should help a great deal in solving the difficulties.

ANOTHER VARIABLE ITEM

of the present method is shown by the conditions existing during the past year. A cloth may have been made of a certain construction one year ago; and this cloth would, of course, have been made of high-priced material. Duty was assessed on the price of the cloth with high material charges entering into the cost of making. Consider the same cloth as made to-day with material which cost very much less, and by the present method of assessing duty, the cost to an importer would be much less than the cost one year ago, and the real

COST PLAN.

Threads per inch = 64.
Warp weight = .0805. Filling weight = .0624.

Warp.	Size of yarn.	Yarn labor.	Dyeing labor.
Beam 1	28/1	2.40	....
Beam 2	....	....	....
Beam 3	....	....	....
Beam 4	....	....	....
Filling.	Size of yarn.	Yarn labor.	Dyeing labor.
Box 1	36/1	3.10	....
Box 2	....	....	....
Box 3	....	....	....
Box 4	....	....	....
Weaving	Yards per week. 242	Wages. $9.50.	Looms per weaver. 16
General expenses	Yards per week. 242	Expenses per week. 17¾c.	
Finishing	Bleaching. .40	Dyeing.	Printing. .45
Selling 2% on cloth price.			

COST PLAN.

Picks per inch = 64. Width = 27". Yards per lb. = 7.00 Price per yard = 5c.

Beam & slash labor.	Mercerizing labor.	Total labor. 2.40	Labor per yard. = .193
Quilling labor.	Mercerizing labor.	Total labor. 3.10	= .793
			= .240
			= .073
Mercerizing.	Napping.	Shearing.	= .850
			= .100
			1.649
*Duty 50%.			50%
		Duty per yd.	.8245

*This duty is an assumed one and is used mainly to show the method employed. The percentage of protection necessary could be determined from careful investigation.

facts in the case are that the labor charges may have been identical in both in importations of the cloth. How can an importer be protected for cloths which he may or may not have sold when the price has lessened? Does not the statement of these facts prove the fallacy of the present method of assessment? We cannot see how anyone can believe otherwise, as the facts in the case are clear, and what is more, we do not believe many mill men think the conditions are right, excepting that in nearly all cases the duties are high enough so that foreign competition is easily excluded. The main point is that they are not as fair to some as they are to other manufacturers, and all should be on the same basis.

A PROPOSED NEW METHOD.

Regarding the suggestion we have made concerning a new method, many may say that men cannot be obtained, but we feel certain that they can and at a fair price, too, considering the ability required. For illustration, we ask how fine and fancy goods are sold in this country. Are they sold from actual costs, or are they sold through some other standpoint? It is needless to designate, for most people know that most patterns of constructions in these lines are rather new, or at least the combinations of constructions and patterns are new, and in many, if not most cases, samples even are not made before contracts are accepted. It can thus be seen that goods are sold from cost estimates, which are made up from a sample of cloth, which is to be duplicated, or from details of construction which are asked for. The selling of cloth in these lines proves conclusively that mills must know their material charges, and also their labor charges to a very small fraction of a cent, or correct prices cannot be made, and as profits in many lines are made in small amounts per yard, it can be seen that known facts are used in connection with these figures. The

ABOVE STATEMENTS PROVE

that an average labor charge could be obtained for the various grades of yarn and cloth based on scientific data, and from such information a system could be worked up which, in a short time, would be far more valuable than the present method. By this we mean that all mills would enjoy the same percentage of labor protection. Of course, some mills

would still make more profit than others, because of more economical conditions and operations. It might be found necessary even to raise the percentage of duty from the present, but the result would be accurate, and there would be no such variation as at present. We believe a number of men like Mr. Langshaw could, if they would, in a few days' time, frame a far more accurate system, which would be based on scientific facts than the present board with its large expenditure can or will make through a year's experimentation, unless they produce something more valuable than the present methods when their report is submitted.

PERFECTION OF COST SYSTEMS.

Because manufacturers framed the present tariff and left vagaries in it may have been policy, but cost systems are just beginning to be perfected so as to be accurate, and they may have done the best possible with the knowledge at hand, making duties high enough to protect all. Each piece of cloth under this new system would have to be treated differently, and various details of information in regard to manufacturing would have to be known by the expert, but this would not require a large force, because it is possible to give cost estimates which are accurate on as many as 1,500 or more samples a year. A system of filing could be arranged whereby in time it would be only necessary in most cases to look up previous constructions which have been treated. In this discussion we have treated not merely cotton cloths, but mixtures of cotton and silk, cotton and linen and other combinations, and it seems possible that it could be equally as well applied to silk and woolen goods, and the results be as accurate as would be necessary to protect American industry, and not only this but to eliminate for all time the large variation in duties, which are not necessary or advisable. In explanation of the process, we will

SUBMIT A PLAN OF COSTS

based on the method we have suggested. Different plans could be used for various grades of cloth, but, to make the idea as clear as possible, we will use a simple cloth, and will give detail as necessary. The figures used will be approximately correct, and although changes might be necessary, the fundamental idea could be used. We firmly believe some radical change will be necessary before mill men, importers or the general public will be satisfied that politics has not played a larger part in the tariff than any scientific data, however carefully compiled. The fundamental principles are wrong at present, and will stay wrong as long as the method is used.

In explanation of the plan, as laid out, it can readily be seen that we have given the total labor cost on the yarn per pound, and this cost includes the labor of making the yarn, spooling, warping, slashing, and drawing-in, and brings the labor cost up to the weaving operation. This makes a dividing line

BETWEEN YARN AND CLOTH.

If more detail is needed on the yarn cost, it can be subdivided into the various processes. This might be advisable if a plan such as this were used. We have also made divisions wherein, when cloth is dyed or bleached or processed in various methods, the cost of the various operations can be given. The whole cost can be subdivided much more than we have done. There should be sufficient spaces left in any plan, so that the number of warps and fillings could be given, and we have left spaces for four different warps and fillings. The weaving operation is usually done as piece work, and to a man familiar with fine and fancy weaving a loom speed and percentage production can be assumed which will be practically accurate. It is also possible to assume the number of looms which a weaver can run in ordinary cases, and also the wages which would be made. From these items, the weaving cost per yard can be determined accurately. The general expenses give us the labor cost, after the yarn has been made, and includes the labor up to the finishing process. It is apportioned on the loom basis, and the production per loom determines the cost per yard.

The finishing charges are subdivided into various processes, but they can be extended on any plan into as much detail as is required, and more than we have attempted to do. The labor cost alone is used in these figures, and no allowance has been made for material or supplies which we have assumed every one should use in practically the same amounts. In the selling costs, it would seem good policy to give a certain percentage of the cost selling price. We have used 2 per cent, which would be correct in some cases, and too low in others, but it possibly covers the cost of selling on many of the cloths which are made of grey yarn.

From the above details, it can be seen that the total labor cost is given, and if the difference in the labor cost is 50 per cent in favor of Europe, then 50 per cent added will place both countries on the same manufacturing basis, leaving out the extra cost which it is claimed a mill will cost here. A certain percentage can be added for this difference, and then, if a certain amount of protection is desired, the percentage can be raised to cover the difference in cost of labor plus the desired protection. It would appear that a system which is

BASED ON SCIENTIFIC FACTS

would be much more accurate than any other, and that it would eliminate the injustice of the present method. It is certain that sooner or later known facts will have to be used more than they have in the past. A sample of cloth could be kept with every cost plan, and with any accurate system of filing on very many qualities of fabrics, it would not be necessary to make a labor cost, for reference could be made to previous samples, and the cost plan duplicated. The plan given would need adjustment to suit conditions as they develop, but the fundamental facts could be used in evolving a satisfactory system, and it is a fact that sooner or later it will be absolutely necessary to use a system in which these principles form the basis of operation. Whether the present tariff board considers such a system or not, it will be necessary to incorporate fundamental facts if real progress is made on the present situation.

DESIGNER.

COTTON CLOTH COST FINDING.

A Key for Cloth Buyers and Cloth Makers.

The American cotton cloth industry has developed rapidly during the past few years, but just how fast few really realize unless they have been in close touch with selling conditions. Formerly, most of the fabrics produced were made from coarse yarns, and the patterns were made largely by the introduction of colors, while to-day the styling and weaves are of great variety, with yarns of much finer sizes and very much better quality. Naturally, such a development has been brought about through the demand of consumers, but along with this increased demand there have arisen many problems of selling and making which at one time were not of great importance.

In the first place many of the new lines of cloth are handled by converters or converting jobbers who place orders for fabrics and who designate what the cloth constructions and patterns are to be, and in this way the manufacturer is more a cloth maker than he is a cloth or style developer. In a large number of cases, this converter asks a mill treasurer to quote a price on the fabrics or combinations which he desires and which the mill has not previously made, and, therefore, a manufacturer must have some means of knowing fairly accurately the cost of making any cloth his mill is able to produce. This necessity has resulted in the keeping of careful records and from such records economical cloth making has partly been due.

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*This little Key is the most valuable book ever offered to the Textile Industry of the world, and the copyright will be protected to the extent of every line contained herein.

This cotton goods cost key is for grey cloths and is the net mill cost with no profits at all added.

The building of large mills, together with the great increase in competition, has also been responsible for the lowering of costs of production, as has the greater general knowledge regarding the fine points in fabric making. Under such conditions as have developed, even the older mills, which make fabrics of bleached and colored yarns, have found that a better knowledge than formerly is necessary regarding the costs of cloth making, that is if they continue in the race with others, and if the fabrics they produce be the ones which show the best margins of profit.

The cost systems which have been developed are, many of them, fairly satisfactory in the plant where they are used but are of comparatively little value to others, and it can be said that there is about as great variety in the methods which are employed as could well be imagined. Admitting that these methods of finding costs are satisfactory to the mills using them, it will be seen that they give more or less protection to the cloth maker in that he can quote a price to a buyer which may or may not be exhorbitant. The buyer has no protection at all excepting that obtained through asking quotations from different sellers for the same cloth, and through his own judgment regarding the price at which the cloth will sell.

Because certain trained cloth makers have information of the above nature they are of value to cloth buyers, making money for them by saving it. Recognizing that a cloth buyer is just as important in distributing as a manufacturer is in producing, and knowing that absolutely no reliable information is obtainable on the subject, we are presenting a few general rules which will be of great value to buyers, and which will give a certain amount of aid to manufacturers.

FABRIC ANALYSIS.

It should be readily seen by anyone who understands anything about cloth that any reliable cost system must be based first on certain fundamental facts of cloth construction. In this it is no different than any other problem of construction, for the items material, labor, insurance, supplies and all the other details must be considered carefully. To many the problem appears very complicated, because the items for cotton cloth are so small per yard.

COST ESTIMATE.

A cost estimate is either made from a stated construction or from a sample submitted, and as making a cloth analysis consists in obtaining the cloth construction, the problems are identical when this has been accomplished. There are two facts upon which cotton cloth construction depends, first, that No. 1 yarn contains 840 yards per pound, No. 2 yarn contains 1,680 yards per pound, and so on, or, in other words, that No. 50 yarn contains 50 times 840 yards, or 42,000 yards per pound, and second, that a pound, as used for yarn, contains 16 ounces or 7,000 grains.

In giving all of our estimates we have attempted to make the problem as simple as possible, not only regarding the yarns and their cost but also regarding the cloth and its cost of making. We have, therefore, laid out the cost on an average number basis, and while this has its defects, it gives results which are fairly accurate, and which are much more reliable than some mills have been in the habit of obtaining. The results are ones which might be noted in any medium-sized, economical plant, and while some operate at a lower cost, there are others which have a higher cost, and, in this connection, the figures given will be of value. Under certain conditions, some cloth buyers or cloth makers may desire to understand the method of analyzing a piece of cloth, and we, therefore present such a process.

ANALYZING CLOTH.

The first step in making a cloth analysis is to obtain the number of threads and picks per inch, and this is accomplished either by cutting out a certain amount of cloth with a die

and then pulling out the threads and counting them, or else by counting the threads with a magnifying glass as they stand in the cloth. The threads per inch in the cloth multiplied by the cloth width will give the number of threads in the warp unless there be a special pattern where extra threads are used. This is, of course, not considering the selvages, for they are usually about a quarter of an inch wide on each edge of the cloth, and contain about twice as many threads as the ground work of the fabric.

The next step is to obtain the yarn sizes in the cloth being considered This is done by pulling out threads and then weighing on accurate balances. The amount of yarn to be weighed will depend somewhat on circumstances, but any amount over 100 inches will give satisfactory results if the balances be accurate, although, of course, it is often possible to obtain only a few inches of cloth, and estimates must be made under such conditions. To illustrate the method used in finding the size of yarn an example may be of service.

AN EXAMPLE.

If 124 inches of yarn be pulled out and then weighed and the weight is 1 1-10 grains, what is the yarn size? The formula is:

$$\frac{124 \text{ inches} \times 7{,}000 \text{ grains}}{1.1 \text{ grains} \times 36 \text{ inches} \times 840 \text{ standard}} = 26/1$$

The result as obtained will be clear enough to anyone having any experience, but an explanation may be of value. If the 124 inches which were weighed be divided by the weight, or 1 1-10 grains, the result will be the inches per grain, or 112 7-10. As there are 7,000 grains per pound, the inches per grain times 7,000 will give inches per pound. If this result be divided by 36 inches, it will give the number of yards per pound, and when any given number of yards of cotton yarn weighs a pound, the size can easily be obtained by dividing by 840 yards which is the standard for No. 1 yarn.

Of course, in making any accurate analysis there are also other facts which should be obtained, such as the take-up on the yarn, or yarns used, both warp and filling, and the warp pattern or weave, if the cloth is to be duplicated. The take-up can be obtained approximately by pulling out yarn and measuring the length obtained and comparing it with the length of the cloth woven from it.

As an illustration, the following may make the process clear: A thread is 6½ inches long when it is woven in the cloth, but stretches to 7 inches when pulled out. What is the take-up?

7 inches — 6½ inches = .5 inches.
.5 inches ÷ 7 inches = 7% take-up.

With a little experience, the result obtained in this manner will be entirely satisfactory.

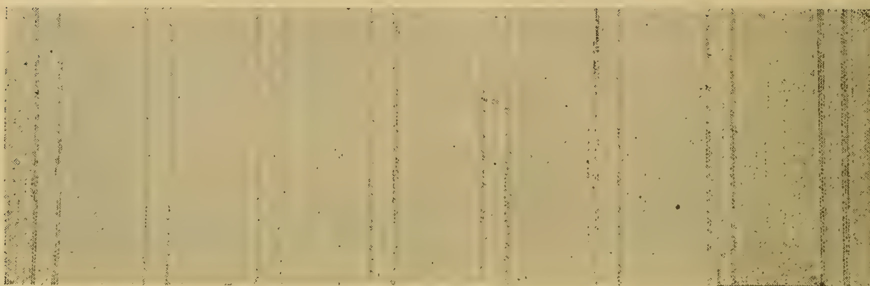
THE PATTERN.

When the fabric has a pattern in it, some kind of a plan must be made if an accurate analysis be desired, but this is only necessary in certain instances in the plan such as we have used in our system of costs. Following we give a plan which may be of service. The first step is to obtain the width of the pattern, and by dividing the width of the cloth by that of the pattern the number of repeats of the pattern may be obtained, and from this result the number of ends or threads of the different yarns in the warp.

Cloth width. 35¾″. Selvages, ¼″ total.
Pattern width, .51 inch.
35¾″ — ¼″ = 35½″ ÷ .51 = 69 3-5 repeats.
Note that the selvages are narrower than is usually the case.

PATTERN BLUE SAMPLE

	2										2	
60/1 American combed	12	32				4				32	12	= 2,564
30/1 American combed blue				2				2				= 276
30/3 American carded			1		1		1		1			= 276
		69 ×										3,116



To make the process as simple as possible, the system as we have planned makes it unnecessary to analyze a piece of cloth so as to be able to find the cost of making. A few items are, however, necessary, and they should be readily understood. One fact which it is necessary to know is the width of the cloth. Another is the threads and picks per inch. On these two facts, together with the take-up and the fundamental facts regarding yarn weights and sizes, the following system is founded. In a general way, the yarn take-ups in ordinary cloths may be about 10 per cent, and we have used this figure in our explanation.

The take-up will probably be more than the amount given on heavy and less on light fabrics, and if more accuracy be desired than that obtained through the use of 10 per cent take-up the threads and picks can be pulled out, and the actual take-up of the cloth noted and averaged, and in this manner a better result be obtained. It is admitted that yarn sizes are much different when finished cloth is being considered, but, due to handling and processing, the yarns are generally finer in finished cloth than they are in grey cloth. Usually, a yarn which is 50-1 in grey cloth will become about 55-1 in finished cloth or, in other words, it will be about 10 per cent finer. This fact should be considered when a finished cloth is being analyzed, or when the cost of making is being obtained.

THE AVERAGE NUMBER.

To make the method clear, we will follow out the process of obtaining the average number from an ordinary fabric. A wide standard print cloth contains 64 threads and 64 picks per inch. It is 38½ inches wide in the grey state and weighs 5.15 yards per pound. If the threads and picks be added together (64 threads plus 64 picks equals 128 total threads per inch), and then multiplied by the cloth width, it will give the number of yards of yarn in a yard of cloth without the take-up on the yarn. This gives as a result 4,928 yards of yarn. As we have previously stated, there is a 10 per cent take-up, and if this be added, the result will be 5,476 yards of yarn (total) in a yard of cloth. As there are 5.15 yards per pound in this cloth, if the yards of yarn per yard be multiplied by the yards of cloth per pound, the result will be the number of yards of yarn per pound (5,476 times 5.15 equals 28,201 yards). If this number of yards of yarn be divided by the standard number of 840, it will give the average size of yarn in the cloth as woven, or 34 (28,201 divided by 840 equals 34). This result forms the basis of estimating the cost of the material which enters into each yard of cloth.

If there be a pattern in the cloth

which contains cords or extra threads, all that it is necessary to do is to obtain the number of threads in the pattern and the width of the pattern, and then the total number of ends in the warp can be obtained as previously explained. When there is a check in the filling, the same process can be employed, and by adding the average number of threads and picks per inch together the average size can be obtained, just the same as if only one size of yarn had been used in warp and filling. Following are presented the figures previously obtained so that the process may be clear:

64 threads + 64 picks = 128, total threads per inch.
128 × 38½", cloth width = 4,928 yards of yarn per yard of cloth without take-ups.
10% take-up in weaving.
4,928 ÷ .9 = 5,476, total yards of yarn per yard of cloth.
5,476 × 5.15 yards per lb. = 28,201 yards of yarn per lb. of cloth.
28,201 ÷ 840 standard = 34, average yarn size.

ITEMS OF YARN COST.

The method we have adopted shows in a simple manner how to obtain the average size of the yarns which compose a fabric, and the next problem is to obtain the costs of these yarns. In obtaining the cost of yarn the first item which is of importance is the cost of the material or cotton. This cost will vary in different years and in different parts of the same year, so that no figures are absolutely reliable except for a comparatively short time after being presented, but a simple rule will serve to make the results very accurate. In the costs, as we have laid them out, the yarn costs are based on cotton which costs 14 cents a pound for Middling Uplands grade at the mill, or on to-day's basis of costs. This makes the cost of cotton about 13¼ cents, as quoted in the cotton exchange. If cotton should decline 2 cents a pound, this amount subtracted from the price of yarn as given will be accurate enough for all ordinary purposes, and if the price of cotton should advance, any extra charges over the 13¼ cents, as quoted on the exchange, should be added to the price of the yarn as given. The finer yarns are, of course, made from longer staple cotton, but it has been found that the advances for the different lengths of staples are quite regular, and that if the advances or decreases noted on Middling Uplands grade be added to or subtracted from the yarn costs as given and made from longer staple cotton, the results will be entirely satisfactory. The price of Middling Uplands can always be obtained from any good textile paper.

LOSSES IN PROCESSING.

When the price of cotton has been obtained there are, of course, certain losses in processing at the mill which make the net cost of cotton in the yarn somewhat higher than it was when purchased. We have considered normal conditions in the amounts of waste made and in the extra price made necessary through this loss, and, of course, the loss on combed yarn is much higher than that for carded yarn.

In addition to the price of material in the yarn is the cost of the labor of spinning it and getting it in a condition ready to weave, and also the various expenses such as supplies, insurance, depreciation and the other costs necessary in the processes of making yarn. Yarns are not all made with the same amount of twist, and because the twist will vary, the production per spindle will vary, and, naturally, when the production varies, the cost of making will vary, but for normal yarns the cost of the cotton forms such a large proportion that a small variation in production does not greatly affect the total cost of the finished material.

COMBED YARNS.

Not only do combed yarns have a greater loss in cotton but they also have a somewhat larger expense in making, and this has been considered in calculating the costs. Then it is also true that warp yarn made from a certain cotton is likely to be of a coarser size than filling made from the same length of staple. Thus,

30s-1 warp might be made from 1 1-16-inch staple, while the same staple would be used in filling as fine as 40s-1. As we have only given one cost, which is the average for both warp and filling, the change in length of staple comes at a higher number than it would if warp and filling had been considered separately, that is, by obtaining an average price the cost of, say, 44s-1 yarn would be rather low for warp and high for filling, but is a fair average.

Admitting that there are certain faults in treating the subject as we have, but which are due to the fact that it is a short system and one which can be used by those not acquainted with a great amount of technical detail used in cloth making, we give the following table of yarn costs for both combed and carded yarns:

YARN COSTS FOR COMBED AND CARDED YARNS.

Including All Costs up to the Weave Room.

Size.	Carded. (Cents per pound.)	Combed. (Cents per pound.)
10	14.68	22.14
12	14.92	22.50
14	15.18	22.69
16	15.46	22.99
18	15.74	23.29
20	16.02	23.61
22	16.34	23.95
24	16.66	24.31
26	19.22	24.63
28	19.56	25.01
30	19.92	25.40
32	20.30	25.82
34	20.67	26.23
36	23.27	26.60
38	23.68	27.04
40	24.05	27.44
42	24.47	27.91
44	24.95	28.42
46	27.63	31.51
48	28.12	32.05
50	28.60	32.56
55	29.77	33.86
60	33.08	37.62
65	34.58	39.23
70	.....	43.39
75	.....	45.09
80	.....	49.49
85	.....	51.52
90	.....	56.21
95	.....	58.44
100	.....	63.11

METHOD OF USING YARN KEY.

We have previously explained how to obtain the average number in any piece of cloth, and it is a simple process, for all that is needed is the total average threads and picks per inch, and by actually weighing the cloth, the average size of the yarn can be obtained. Buyers can obtain the weight of the cloth and the count because it is usually given in the contracts made, but when it is not available, it can be very easily obtained. We have found that the average size of yarn in the standard print cloth is about 34s-1. By referring to the table we find that for carded yarn the cost of making, including the cotton, is 20.67 cents per pound. This cloth weighs 5.15 yards per pound, or .194 pounds per yard. If this cost be multiplied by the actual weight per yard of the cloth, the cost of the material can easily be obtained, which enters into each yard of the cloth, (20.67 cents per pound times .194 equals 4.01 cents, cost of material).

COMBED AND CARDED YARNS

Some buyers may not be able to distinguish which fabrics are made of carded yarn and which of combed yarn. When a buyer makes a contract this is usually stated, but for those who are not in position to obtain this information, it can be said that the cloth appearance in a large number of cases will make this fact plain.

When yarns are finer than 60s-1 they are almost always made from combed stock, while there are also all the mercerized fabrics and most of the piece-dyed fabrics which are made from combed stock. When a piece of grey cloth is obtainable, or when it is being analyzed and if it is made of carded stock there is likely to be a good many small specks which are not often present when the combed yarn has been used. Cloth made from carded yarn is also likely to have a certain amount of roughness which is not present in combed work. A little experience will enable one to estimate pretty accurately whether a fabric has been made from carded or combed yarn. If combed yarn has been used, the

prices should be used as given under the combed heading in the table.

CLOTH COSTS.

We have already shown a method by which the average size of yarn in any piece of cloth might be obtained, and have also given a table in which there are included the price of material, labor, expenses and other details necessary in the making of yarn. With the average number and the average price, the cost of the material in the yard of cloth is easily found, but there are other costs which are necessary before the total cloth cost is obtained. These are the costs of weaving and the expenses which naturally go with it, together with the expenses incurred in selling the cloth.

WEAVING COSTS.

It must be admitted that there are a very great number of costs possible for weaving any certain kind of cloth. In the first place, there are certain fabrics which are being woven on ordinary looms, and at the same time, being produced in other mills on automatic looms, and, naturally, the cost of production will vary. Then it is also true that one mill will use a somewhat shorter staple of cotton in its yarn and then run its looms somewhat slower and with a consequent loss in percentage of production. Other mills will use a better quality of cotton which costs more, and, therefore, be able to run the loom somewhat faster and obtain a greater percentage of production.

Each mill has certain problems which are individual and which must be worked out to their own satisfaction, but the variation taken all together for yarn and cloth is not so great as many suppose to be the case. There are so many automatic looms in operation in the domestic market that they should be considered when the price is being obtained on any ordinary fabric which can be produced on them. Under such circumstances, practically all kinds of plain cloth, sateens, twills, plain shirtings, duck, denims, sheetings, towels, drills, lawns, cambrics, pillow tubing, ginghams, flannels, etc., should be considered as woven on automatic looms, for they do make the price lower. It is often a fact that a certain cloth is being made on automatic looms and is returning a fair dividend at a certain price, while it is also true that the same fabric is being made on ordinary looms, and is returning the manufacturer practically no dividends.

PRICE AND COST RELATIONS.

A fact which is of importance in any cost is the relation of prices to costs. The price of cloth to-day shows a high profit when automatic looms are used, and a medium one where non-automatic looms are used, but the price of cotton to-day is high, and many manufacturers are using cotton in the cloth which they are selling which actually costs them 2 cents a pound less than the present price, and which on an ordinary wide print cloth would return them about two-fifths of a cent per yard more than if they found it necessary to buy their cotton at to-day's price. This two-fifths of a cent per yard will make a difference in profit obtained of from 7 to 8 per cent and explains why profits do not appear any higher in our estimates. In obtaining any cost of yarn the cotton cost must be first checked up and then the process is simple.

We have given one table which contains the cost of weaving, including the expenses per loom and the selling costs per yard for cloths containing from 20 to 124 picks. Our yarn cost contains everything up to the weaving operation, while the cloth or weaving cost embraces everything which is not included in the yarn costs. Recognizing that loom speeds will vary and that percentages of production will vary also, we present the following table, which, together with the yarn costs, will give the cost on all ordinary fabrics. We have given the cost which should be noted with a moderate loom speed with a rather low percentage of production and a comparatively small

number of looms per operative. Many mills are able to do much better than the figures given in the table, but for average conditions, the table will be found to be very accurate.

PLAIN CLOTH COST.

Including All Costs Beginning With Weave Room.

Picks.	Costs per yard.	Picks.	Costs per yard.
20	$0.0025	70	$0.0096
22	0.0028	72	0.0099
24	0.0031	74	0.0102
26	0.0034	76	0.0105
28	0.0037	78	0.0108
30	0.0040	80	0.0110
32	0.0042	82	0.0113
34	0.0045	84	0.0116
36	0.0048	86	0.0119
38	0.0051	88	0.0122
40	0.0054	90	0.0125
42	0.0057	92	0.0128
44	0.0060	94	0.0130
46	0.0062	96	0.0133
48	0.0065	98	0.0136
50	0.0068	100	0.0139
52	0.0071	102	0.0141
54	0.0074	104	0.0144
56	0.0076	106	0.0147
58	0.0079	108	0.0150
60	0.0082	110	0.0153
62	0.0085	112	0.0156
64	0.0088	114	0.0159
66	0.0091	116	0.0162
68	0.0093	118	0.0164
		120	0.0167
		122	0.0170
		124	0.0173

EXPLANATION OF TABLE.

As we have already explained the method of obtaining the yarn size in any piece of cloth and through the table of yarn costs we have been able to find out how much the cost of material is for each yard of cloth the foregoing table will enable us to ascertain all the other costs which we have not included in the cost of the yarn. As we figured previously, the cost of material or yarn in a yard of ordinary print cloth, 38½ inches wide, was 4.01 cent. By referring to the table of costs given above, it will be noted that for a plain cloth with 64 picks the cost of weaving and expenses is $0.0088, or a total cost (4.01 cents plus .88 cents equals 4.89 cents). This cloth is to-day selling for about 5½ cents, thus giving a profit of .61 cents a yard. With a normal production per loom this will give a net profit of at least $70 per loom per year, although many mills, through their longer hours and greater percentage of production, would obtain more than this amount. Seventy dollars a loom per year will give a profit on a fair loom valuation of 11 or 12 per cent. Thus it will be seen that any manufacturer who purchased his cotton the present season at 12 cents per pound at the mill is obtaining, with prices of cloth at the present levels, a profit of at least 20 per cent.

In many cases, the profit obtained is more than this amount, for we have not given in our estimates any low figures for any single item, but have confined ourselves to normal conditions which should be noted in every representative mill. With the foregoing explanations, it should be an easy matter to obtain the approximate cost of any cotton fabric which is made on an automatic loom.

FANCY CLOTH COSTS.

As we have already stated, there is quite a variation in loom speeds and percentages of production on plain cloths, but there is an even wider variation in the above items on fancy cloths. The cloth constructions made and various other items are likely to affect the results, and even to the mill which makes the cloth the results obtained are often not ascertainable. The analysis of a fancy cloth or the finding of the average number of yarn used is no different than for a coarser fabric. It is, however, a good policy to find out the take-ups and use the ones found when making an estimate for the yarn size. There are so many varied conditions that only normal cloths can be considered. Such fabrics as all-over lenos or ones on which there is a higher weaving expense, or where less looms than usual per weaver are run, of course cannot be considered on any average basis, because the weaving cost is so high.

The weaving of fancy cloth has, however, become more systematized during the past ten years, and where there is a style which does not run especially well, it is usually placed in a set of looms in such a manner

that it is operated on a basis not much, if any, different than other normal fancy fabrics. Jacquard looms a few years ago were fewer in number to a weaver than they are to-day, and in a great many instances, for ordinary straight tie-up machines the number of looms per weaver is as many as it is for ordinary fancy cloths. For this reason, fancy dobby cloth and ordinary jacquard cloth can be considered on the same basis.

FABRIC WIDTHS.

It would be well to remember that all of our costs as given apply to ordinary fabrics, that is, ones up to 41 or 42 inches wide in the grey. Fancy fabrics are not often made in the domestic market much over 36 inches wide in the grey state, but there are many imported fabrics in these lines which are up to 46 or 47 inches wide in the finished state.

There are many plain fabrics, however, which are made wider than 40 inches in the domestic market, but we have not attempted to present costs on such fabrics, although they will not vary greatly from those given in our table, inasmuch as the material forms such a large proportion of the total cost. Fancy mills usually have quite a variety of looms in their organization, and all these looms cost different amounts, but it is almost impossible to separate the various items and place them on a different basis, and for this reason, ordinary jacquard cloths such as shirtings, waistings and silk and cotton mixtures are sold on practically the same basis of cost as ordinary dobby fabrics. The difference in costs is so slight that for all practical purposes they may be considered on the same basis.

MILL PROFITS.

So far as the profits of a mill or the selling price of cloth is concerned, it can be said that these are largely the result of conditions affecting the sale of goods. Fancy cloth mills, or at least many of them, attempt to obtain a net profit of about \$2 per loom per week, or about \$100 per loom per year, which gives at least a net profit of 10 per cent if the mill be arranged for expensive cloths, while it gives more than 10 per cent profit if an ordinary fancy mill be considered.

The profit per yard will vary depending upon the number of picks per inch, for it would not be a correct policy to expect a 30-pick cloth to return as high a profit per yard as one containing 100 picks. A cloth which was being produced at the rate of 200 yards per loom per week and which was showing a net profit of 1 cent per yard would return about \$2 per week, or about \$100 per year. A plain cloth does not need to carry the same amount of profit, because the total cost per loom of the mill is less for plain cloth than it is for fancy cloth making. Understanding all the above conditions and realizing that there are radical cloths which cannot be considered under any but an individual basis, we present the following table which includes all the costs of fancy cloth weaving.

FANCY CLOTH COSTS.

Including All Costs Beginning With the Weave Room.

Picks.	Costs per yard.	Picks.	Costs per yard.
20	\$0.0072	70	\$0.0274
22	0.0080	72	0.0282
24	0.0088	74	0.0290
26	0.0096	76	0.0298
28	0.0104	78	0.0306
30	0.0112	80	0.0314
32	0.0120	82	0.0323
34	0.0128	84	0.0331
36	0.0137	86	0.0339
38	0.0145	88	0.0347
40	0.0153	90	0.0355
42	0.0161	92	0.0363
44	0.0169	94	0.0371
46	0.0177	96	0.0379
48	0.0185	98	0.0387
50	0.0193	100	0.0395
52	0.0201	102	0.0403
54	0.0209	104	0.0411
56	0.0217	106	0.0419
58	0.0225	108	0.0427
60	0.0233	110	0.0435
62	0.0241	112	0.0443
64	0.0250	114	0.0451
66	0.0258	116	0.0459
68	0.0266	118	0.0467
		120	0.0475
		122	0.0483
		124	0.0491

METHOD OF FINDING COST ILLUSTRATED.

Possibly an illustration of the method as used on a fancy fabric may make the process of finding the cost more evident. An ordinary fancy cloth which is sold in large quantities is the one which contains 64 threads and 72 picks per inch. It is 34 inches wide in the grey state and weighs about 6.30 yards per pound. This cloth is made from combed yarn and is used extensively in piece mercerization. As previously explained 64 threads plus 72 picks equals 136, the total threads per inch. Then we have 136 times 34 inches cloth width equals 4,624 yards of yarn per yard of cloth, not including the take-up in weaving. As previously noted, 10 per cent is a fair average for this take-up, 4,624 divided by .9 equals 5,138 total yards of yarn per yard of cloth. 5,138 times 6.30 yards per pound equals 32,369 yards of yarn per pound. To find the size, this number of yards should be divided by 840, the standard for number 1 yarn. Then we have 32,369 yards divided by 840 standard equals 38.1, the average size of yarn in the cloth.

YARN COST TABLE.

By referring to the table for yarn costs we find that the average price of combed 38s-1 yarn is 27.04 cents per pound. As this fabric contains 6.30 yards per pound the weight per yard is 1.0000 divided by 6.30 or .159, the weight of the cloth per yard. Then we have 27.04 cents times .159 equals 4.30 cents, the cost of the material per yard of cloth. Again, referring to the table of weaving cost, we will find that the total expense and labor for a 72-pick fancy cloth 2.82 cents, so 4.30 cents plus 2.82 cents equals 7.12 cents, the total cost of producing this fancy fabric. To-day's quoted price for the above cloth is 8⅝ cents, so the difference between the cost of making and the selling price represents the net mill profit. 8.625 cents minus 7.12 cents equals 1.505 cents profit per yard. This is practically 1½ cents per yard, and, assuming a normal percentage of production for the fabric being considered, the profit per loom per week would be about $2.25, or per year about $117. This should give a net profit to a mill of anywhere from 12½ to 15 per cent.

Prices are somewhat higher to-day than they have been for all kinds of fancy cloths, but most of these fabrics are now showing very good margins of profit. In assuming a loom production care must be taken to make the estimates low enough to cover all conditions, that is, a fabric might average 85 per cent production after the loom was started, but, due to certain circumstances, much time might be lost in getting the warps into the looms, so that for six months' or a year's time the actual average percentage of production might be nearer 75 per cent, and as a loom does not earn profits when standing idle, only actual percentages are of value. This policy has been observed in the various costs which we have presented in the tables.

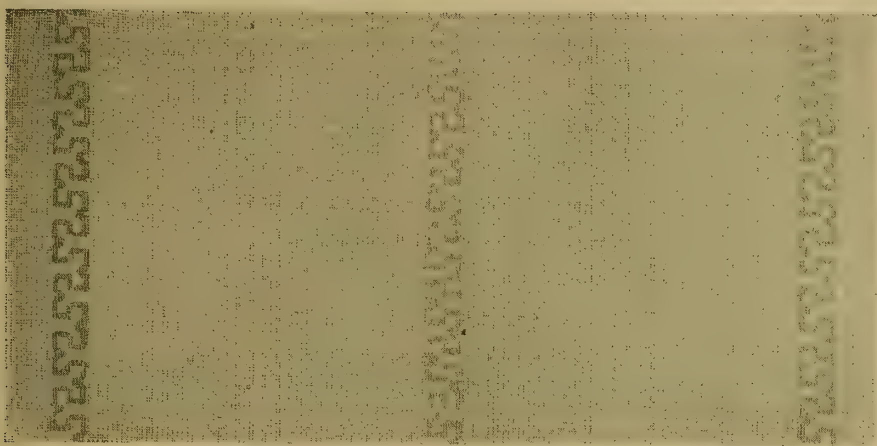
COST OF CLOTH CONTAINING FAST COLORS.

Probably the greatest increase in any one line of fabrics has been that which applies to grey cloths in which yarns fast to the bleaching process are being used, and, inasmuch as a still greater use is imminent, it may be well to give a method of obtaining this cost. For such fabrics the average size of yarn can be obtained just as in the other samples we have considered. When the threads are being counted the number of colored threads per pattern can also be obtained, and by measuring the width of the pattern and finding the repeats of the pattern in the cloth the total colored threads in the warp or filling can be obtained.

When the total number of colored threads are known, it is easy enough to find the percentage of the total cloth weights, at least approximately,

which they form. By adding 18 cents as an average cost for dyeing fast colors per pound to the cost of the regular yarn and then multiplying by the two weights (that of the grey warp and that of the colored) the cost can be determined. An illustration will, without doubt, make the process clear enough so that it can be generally understood. The cloth illustrated is made on a fancy loom. It is 33 inches wide in the grey state, or as it comes from the loom, and the stripes are 1 8-10 inches wide. Then 33 inches, the cloth width, divided by 1 8-10 inches, the width of the stripe, equals 18 colored stripes in the cloth width. The fabric weighs when woven about 6.00 yards per pound. The following figures should make the results readily understood:

Warp count, 95 (over all).
Filling count, 80.
95 + 80 = 175, total cloth count per inch.
175 × 33″ cloth width = 5.775 yards of yarn per yard of cloth without take-up.
18 stripes × 14 colored ends = 252 colored ends in fabric.
252 ÷ 5,775 = 4.36% of color in fabric.
10% take-up in weaving.
5,775 ÷ .9 = 6,417, total yards of yarn per yard of cloth.
6,417 × 6.00 yards per lb. = 38,502 yards of yarn per lb.
38,502 ÷ 840 standard = 46/1, average yarn size.
1.0000 ÷ 6.00 yards per lb. = .167, weight per yard.
.167 × .0436 = .007, weight of colored yarn.
.167 — .007 = .160, weight of grey yarn.
31.51c. per lb. × .160 = 5.04c., cost of grey yarn.
31.51c. + 18c. = 49.51c., cost or colored yarn per lb.
49.51c. × .007 = .35c., cost of colored yarn.
Weaving cost = 3.14c. (from table).
5.04c. + .35c. + 3.14c. = 8.53c., total cost of cloth as illustrated.



Sample of Cloth for Which the Cost Is Given.

Scientific Management in the Cotton Mill

Whenever a new machine is put on the market which is claimed to perform any one of the operations by which cotton is manufactured into yarn or cloth or whenever any new process is introduced which is claimed to be superior to the one already in existence, it is but natural that the interest of all thinking and progressive mill managers is centred on this machine or operation to see whether it could be applied successfully to their particular line of manufacture. In doing this they first ob-

tain all the written or imparted information that they can in order to see just what is claimed for the new machine or process, in what manner the operations are carried out, and in what way said operations are an improvement over existing conditions. If, after careful consideration, they judge that the matter is worth looking into further, they usually arrange to go to some plant and see the machine or operation under practical working conditions.

If still further impressed, the result is most frequently a trial order for one or two machines, which they set up in their own plant and conduct various tests of their own devising. If they are then fully convinced, after a fair and impartial trial, that the machine or process is all that is claimed for it, they usually advocate to the mill treasurer or other officials that, so far as capital admits, they would like to see some of these new machines or the new process introduced into the plant which they are managing. If it were not for this fair-mindedness on the part of the mill managers and their willingness to prove a machine or process right or wrong, what good would it do for men to use the best years of their lives devising means for bringing up the textile machinery to continually

HIGHER POINTS OF EFFICIENCY.

That is the reason why we have to-day the Draper and Stafford automatic looms, the warp-drawing and tying-in machines, the new process of double carding for waste on revolving flat cards, and numerous other smaller devices for improving the different machines used in the processes of manufacturing cotton into finished goods. That is why we find to-day that our textile magazines are reaching a higher standard of excellence, in that they are obtaining and printing articles by men well versed in the knowledge of manufacturing, and able in a practical and technical way to analyze the different processes and show to what extent the process is a detriment or aid to good work, and in addition, give their best ideas as to the remedying of the defects pointed out.

But it seems to be during these years in which the mill managers were studying their machines and processes that they failed to study the human element; that is, the large mass of operatives working for them. It seems to the writer that that is one of the big reasons why it is that to-day we have almost all our mills operated by foreign labor, and good superintendents, overseers, second hands, etc., are becoming harder to obtain as time goes by. Of course it can be argued, and rightly, that the introduction of a great deal of the improved machinery called for less skilled help for its operation, but it certainly called for more intelligent men to take charge of such machinery and obtain good results from same with operatives who can, as a rule, speak but little of the English language and who attain their quickest comprehension when they find a mistake in their pay envelope. When the mill managers saw that

THEIR BEST HELP

were leaving them why did they not pick out some of the most intelligent and make them good inducements to stay in the mill, and offer them opportunities to learn if not all at least some of the processes, so that they would eventually become valuable to the mill as superintendents, overseers, second hands, etc.? Is this not one of the best reasons why there is a scarcity of the number of actually first-class men in the cotton mills to-day? Is it not also a fact that the mills are more than realizing it to-day? For what other reason is it that besides the large textile schools in existence, some mills are running textile schools of their own, allowing boys to work half a day and go to school the other half? Why is it that the sanitary conditions of the mills are being put into first-class condition, the ceilings painted, and all the working conditions made as agreeable as possible? Why is it they are trying to improve the social conditions outside the mill by building clean, sanitary tenements for the help to live

in and, as a rule, a large recreation building offering various forms of amusement? For the very reason that the mill managers are realizing that the textile workers are becoming scarce, and those they have they wish to keep with them, and knowing that it is a hard proposition to pick overseers or second hands from the older workers, they are enabling the younger ones to obtain information which will fit them to hold positions of responsibility in later years.

At the present time in the industrial world there is a great deal of agitation over a new creed called "Scientific Management or Efficiency Engineering." Scientific management is not a new machine or improved process. To describe it exactly is rather difficult but it is that which takes into consideration the process of manufacturing, the

MACHINERY UTILIZED,

and most especially the human element or operatives at the machines. To state it briefly, when scientific management is introduced into a plant, the processes of manufacturing are first observed. Then notice is taken of the machinery layout to see that each machine is placed right for each sequence of operations and through other observations until motion and time studies are arrived at.

When working on motion and time studies, that point is reached where most particular attention is paid to the operative. The number of motions and time required by the operative in his or her functional work is observed to the fraction of a second, and it is then determined if any of these motions are waste or lost motions, that is, those which are not really necessary for the performing of the operation. After determining the shortest possible way of performing the operation, the next problem is that of instructing the employe in the right method.

This is really as hard a problem as any which the efficiency engineer has to solve, and in order to accomplish his purpose he appeals to the side of human nature which has that characteristic which is almost universal, and that is the desire of gain. In other words, the employe is offered a bonus if he performs his tasks according to the methods prescribed by the efficiency engineer and attains a certain output. The efficiency engineer has also to guarantee to the employe that the rate which was set upon his piece of work will not be reduced in the future so that there will be no chance of the employe doing twice as much work as formerly and at no higher rate of wages. In regard to the successes which have been met with by the scientific managers, it must be agreed that the majority have been made in such plants as machine shops, where almost everything can be put on a

PIECE RATE BASIS.

Now what has the attitude of mill managers been toward scientific management? After the scientific managers had made some successes in the other industries they looked around and turned their attention to the textile mills and made the statement that the textile mills were not managed right and were making more waste than any other of the industries. Then the mill managers sat up, and it may be truly said the majority, with antagonistic attitude, and took note of these efficiency engineers who presumed to state that an industry dating way back to the early Egyptians was not properly conducted. And what was more astonishing the men who made these statements had, with hardly an exception, been in a cotton mill before. Here was something that it was a little bit difficult to comprehend. They could understand how a man in the cotton business could invent an improvement in the machinery line or get up a new process, but for a man to come into a cotton mill who had never been in one before and make thousands of dollars in savings was a totally different proposition.

Some mill managers passed the idea by with scant ceremony and still others gave it some consideration. They looked up the records of the scientific managers and saw that a great many had had trouble with the

operatives in installing their management. Then the mill manager thought if these efficiency engineers have trouble with men who are more intelligent than our employes, such as machinists, etc., what kind of a time would we have with our help if we tried to install scientific management? How could we

ESTIMATE A BONUS

that would be satisfactory to both the day and piece rate workers? And then again, won't we have to teach the efficiency engineer all about the cotton industry before he can make any improvements? If he doesn't make any improvements in our plant will he not be enabled to go to a less better managed plant and impart some ideas carried from us to the betterment of the poorer plant? In these days of competition we cannot afford to give our rivals any more advantage over us than we can help.

These are only a few of the questions which the mill managers asked themselves, but in the end it generally led to their giving the matter less and less thought. A few, however, still centered their interest on the question and found that the efficiency engineer did not pretend to know anything about the cotton mill. In fact, he will admit that while he can make a good showing he will be able to make a still greater one if he has the hearty co-operation of the mill management and employes with him. What he does claim, however, is that he has methods which will enable him to make very accurate motion and time studies, and employs only experts in this line who determine what the waste motions are, and, by eliminating them, achieve great savings in time and

INCREASE PRODUCTION.

Now some mill managers have come to the conclusion that there is, after all, something to this scientific management but do not yet feel that they care to bring an outsider into their plant. Some people claim that if a mill is running along and holding its own with its competitors it is better to let well enough alone, but some day it might wake up and find that some one of its competitors was way ahead of the game, due to the fact that it was beginning to pay attention to the elimination of its wastes. Then it is surely time to take notice and see what can be done in one's own plant.

A mill manager, in order to make a saving in his plant, does not necessarily have to call in the assistance of an efficiency engineer. If, as the case would most likely be, he finds himself too busy to go into all the details of investigations himself, he should establish what might be called an

EFFICIENCY DEPARTMENT

in his own plant. Perhaps at the start this department need consist of only two men, that is, one good man and an assistant, who will make the desired investigations and make reports with suggestions for improvement to the mill manager, who in this way keeps in touch with all that is going on and makes all important decisions. All the work done by this efficiency department should be carefully tabulated and all reports, blue prints, data, etc., should be kept on file so as to be available on short notice.

To bring a cotton mill up to a high standard of efficiency is a different proposition from that of a machine shop and would, therefore, have to be attained by different methods. In the first place, let us consider the power question. The efficiency department should begin its investigations here and determine if the power is so generated and distributed that at all times, except in the event of an unforeseen break-down, there will be plenty of power for all departments. As is known, in order to have a smooth running and profitable business, there must be no delay in the processes supplying stock from one department to another. As an illustration, let us take, for example, a mill that is running to its full capacity. On account of a shortage of power the pickers have to be shut down for a while. In a short time it is found that the cards are waiting for laps, and the shortage will gradually proceed through the

different manufacturing processes until it is found that the looms are waiting for filling. For instance, twenty looms running 160 picks per minute and making a fabric which has 40 picks per inch produce a little over two yards per minute. How long can a mill afford to let these looms wait for filling?

Being assured that there is plenty of power the efficiency department should then determine if said power is transmitted in the best possible manner, and if not should suggest methods for remedying same. The fact as to whether shafting is properly leveled and lined is an important one in the

TRANSMISSION OF POWER.

The care of belting is another important fact which is being considered to-day more than ever before. It might be well to take a look at the boiler room and see if things are handled there in an economical manner. For instance, is coal shoveled into cars and then pushed into the boiler house where the installation of a conveyor would do a great deal more work with half the labor? Are the ashes that are shoveled from the pit conveyed away in the best possible manner?

In regard to the actual generation of the steam in such ways as the firing of the boilers, whether by mechanical or hand stoking, the methods of heating the feed water before entering the boilers, the metering of the feed water, the installation of steam flow and pressure meters, the testing of coals to find which give most steam per pound of coal, and the methods for doing these things are best determined by an expert in that line.

What the efficiency department can do, however, is check up the engineer and see that he quickly repairs steam leaks in his mains and keeps accurate records of coal used and things of that nature.

Let us now look at the manufacturing end of the business. How is the raw stock handled when it comes into the mill yard? Have the best methods been obtained of weighing the bales, taking the sample from each bale, and the storing of the bales in the storehouses? Is there any instance where conveyors can be used instead of trucks?

The first process in the manufacturing is the opening of the cotton. In doing this, do you have your opening room adjoining your storehouses and convey the cotton to the picker room either by the blowing system or lattice conveyor, or do you truck your cotton from the storehouse to the opening room or picker room? Is there no way by which you can eliminate unnecessary trucking or handling? Can you not install machines to open your bales where, at present, you open them by hand, and by so doing,

SAVE TIME AND LABOR.

Of course the writer understands that the conditions in any two mills are hardly ever similar, but it does not always prove that the method in vogue is the best.

Let us consider the picker room. In the first place, are there enough machines to take care of all the cards without overspeeding? In the second place, are the machines laid out in the best possible manner so that there is plenty of space for the operatives to work, and does the stock pass from the bins through to the finisher picker without unnecessary handling? Are all the machines in the best possible running condition? It is essential that pickers should make good laps, otherwise they cannot be expected to make first-class yarn. How are finished laps conveyed to the card? Are trucks, elevators, or lap elevators used? Can any improvement be made in the conveying system? A suggestion is given here for a little time study. Suppose there were twelve finisher pickers in a row which were doffed by two men, six pickers to each man. Now, instead of one man doffing six pickers alone, suppose the two men doff the twelve together. To do this, the first man presses his foot on the friction lever, allowing the presser arms to rise. The second man then takes hold of the handle of the iron lap roll on which the lap is wound and pulls it from the lap, leaving the

lap rod behind. The first man then takes the lap and places it on a truck and goes to the second picker, during which time the second man has started the first picker and another lap is in process. By the time the second man gets to the second picker the lap roll is ready to be drawn out. When all the laps have been doffed, both men help in inserting lap rods in the lap rolls. This method of doffing will be found a good time saver.

The card room is the next proposition.

THE PROPER METHOD

of arranging the machinery of a card room has been discussed quite frequently in textile papers, and there has been found quite a diversity of opinion on the subject. However, the mill manager must decide if his card room is laid out in the most efficient manner for his particular case. The main idea is to pass the stock from the cards through the fine frames with the least amount of handling and trucking. He should see that his carding overseer keeps his frames in the best possible running condition. Cards should be kept ground and well set. A good system is to have all the cards numbered and every time a grinder has finished grinding and setting a card he should hand in the number of that card to the overseer. The overseer should make it a point to look at each card when first started, after being ground, and he can easily see what kind of a job has been done by the condition of the web. The overseer should also pay

PARTICULAR ATTENTION

to keeping his room well balanced; that is, seeing that there are no idle spindles on any of the frames that are running, that the drawings do not have to wait for card sliver, the slubbers for drawing sliver or the intermediate and fine frames for back roving. He should also have it so systematized that he has plenty of laps in the room ready for the cards, that as soon as a can is full of card sliver there is an empty can ready to take its place; and the same applies to the full cans at the drawing frames. When the slubbing, intermediate and fine frames are about ready to doff there should be empty bobbins on hand in advance, so that the frame tender will be able to distribute them on the traverse rail before having to stop the frame. He should also have doffers to help the frame hands doff their frames and get them started again with the least possible delay. It is only by such methods as these that an overseer can expect to attain a maximum production.

The spinning room of a mill is usually a hard one in which to obtain the production that should be obtained in this department. This is due largely to the fact that the doffing is done by the younger element, and they require to be watched most closely to see that they doff and start up a frame as soon as the bobbins are full. In order to get good production the doffers should be at the frame with their

DOFFING TRUCKS

and boxes of empty bobbins before the frame is stopped, and, after doffing, should not leave the frame until it has been started and all ends pieced up. The overseer should see that the creels have roving enough so that there will be no spindles stopped on account of roving. The band boys should be going constantly among the frames looking for broken bands. The spinners should be watched closely to see that they keep up broken ends. The overseer who tries to run a spinning room to-day should be a man who is on the job every minute of his time. If he is not, and does not put energy into his work, his production will fall far short of what it should be. As the spinning room is almost all day work the help do not feel that they are losing anything financially if the frames are stopped, and therefore do not tend to be as industrious as they would if paid for the production obtained from their frames. This is a subject which it would be well for the efficiency department to study closely and figure out methods for improvement. The writer will not go into the numerous other details necessary to keep the frames in good condition, but if a mill

manager finds that his overseer of spinning is not quite up to the mark he should attempt to get another one as soon as possible, as this department requires a very efficient man under the running conditions of to-day.

Spooling is the next operation. The efficiency department should see that the bobbins of yarn are brought to the spooler tenders and that they are kept supplied with empty spools and the full ones taken away. A very good production can be obtained from the spoolers, and the room should be so run that the spooler tender does nothing but tend a certain number of spindles, all supplies being brought to her and her finished work removed.

In warping, the idea is to get new spools of yarn tied in as quickly as possible after the spools in the creel have run their limit. The full spools should be at the back of the creels for the tying-in girls, and a box for them to throw the empty spools into. The method of conveying the spools to and from

THE SPOOLING ROOM

should be observed by the efficiency department to see if some shorter method or route cannot be obtained, such as having chutes, conveyors, or something of that nature.

The dressing or sizing of the warps is a thing that cannot be hurried. The speed of the slasher must be determined by the slasher tender, as it is left to his judgment as to whether the yarn is drying properly. What can be done, however, is to have the warper beams in close proximity to the slashers and arranged on platforms, according to the size of yarn and number of ends, and some method can usually be arranged whereby the beams can be picked up with the aid of chain falls running on overhead track and brought to the slasher, thus saving time and labor when putting another set into the slasher. There should also be as little time lost as possible in doffing the loom beams at the slasher.

The loom beams should be taken to the drawing-in girls, whose efficiency depends on their aptitude for this work, some girls being more proficient than others. Drawing-in is trying work for girls, and the conditions under which they work should be made as pleasant as possible. They should be placed in a position where they will have as even a temperature as possible all the year round and where they can obtain the best possible daylight. The

WORKING CONDITIONS

of these girls add to or detract, to a great extent, from their efficiency.

The next process is the weaving. To make it possible for the weaver to obtain good production, there should be a new warp ready to put into a loom as soon as the old one runs out. The weaver should attend strictly to the weaving only and should not be allowed to try and fix any of his looms. There should be plenty of loom fixers in the room, so that no loom will have to wait very long for repairs. Filling boys should bring the filling to the looms and fill up the weavers' filling-boxes for them. Looms should be so arranged or apportioned to a weaver that he or she can move about them with the least possible walking. For instance, it has been found more profitable where a weaver is running twenty looms to have him tend ten looms in one alley and ten in the next adjoining alley, instead of having him tend twenty in the same one. One especially good feature is the supervision that the weaver has over his looms. If he tends twenty in the same alley it is

RATHER DIFFICULT

for him to see down to the lower end and notice if all looms are running, whereas, if he tends ten looms in one alley and ten in another, he can see all of the twenty with ease and quickly get to one which has stopped. There is a good opportunity for the efficiency department to make time studies by watching the different methods of the weavers. It will be noticed that the weavers who get the best production are those who strive to keep all of their looms going all of the time. It will be noticed that while they are working on a loom to repair broken warp threads, or something of

that nature, they will stop frequently long enough to glance around and see if any of their other looms are stopped for filling, and, if so, will stop working on that particular thing long enough to replenish the loom with filling and start it weaving. In this way a weaver gets more production than would be possible if the other looms were allowed to wait for filling while the break at that particular loom was being repaired.

When the cloth is taken from the looms there are

DIFFERENT METHODS

by which it is finished and shipped. The efficiency department should see that the cloth is being passed through the different finishing processes as economically as possible, and that there is no trucking of material where conveyors can be used to advantage If goods are to be stored they should be done so as economically as possible. One mill has a conveyor whereby goods are taken from the finishing room over the tops of the storehouses and switched into any one of the storehouses as desired. In shipping goods it is desirable that the railroad tracks should run either into or near the shipping room so that goods can be loaded easily.

The writer has briefly given how the efficiency department should first see that the power question is all right and the machines laid out to best advantage for all the processes of manufacturing. When this has been done the efficiency department should then begin to standardize the machines and their production. For instance, it should be determined at what speeds the different machines run the best and what production can be obtained at that speed. The machines should then be driven at these determined speeds. Accurate methods should be used for keeping an account of the amount of production for each department, and these reports should go to the efficiency department, which shall determine from the standards what per cent of production is being obtained. The mill manager should receive a report of this in a condensed form, so that he can see how things are running and get in touch with the overseers who are low on production.

The last thing to be considered is the bonus, and the writer does not believe that this question should be raised in the cotton mill, nor should one stand over the help with a stopwatch and take account of all their motions. If, however, the points that he has tried to bring out are carefully observed, the help will be able to get a bigger production, piece workers will receive more wages, and it will be found that the cost of production will be lowered without the help realizing that home-made scientific management is being practiced on them.

Use and Abuse of Belting

There being so little said about belting, I venture to give some of my experiences. I think one of the most important things connected with power is the belts. There seems to be little known about their handling, care and management. In the first place, we give a man a belt to put on and ninety-nine times out of a hundred he will put it on wrong, that is, the wrong side to the pulley. The reason for this is quite natural, because the finished or smooth side of the belt would look better on the outside, which is entirely wrong. I have in mind one instance, and in fact it is running to-day, a belt which was put on fifty-one years ago. The same is

22 inches wide and is drawing 250-horse power. It is in good condition to-day.

Doping the belts now and then with almost anything that happens to be handy and lacing the belts in any manner that will cause them to hold together and run will not bring the desired results, and as a natural consequence, the change from belt to electrical-driven machinery will appear to be the more practicable means of economizing.

During the past three years, some interesting data has been obtained relative to the possibility of reducing friction losses in belt-driven establishments by a careful and inexpensive treatment of the belts. In one factory the dead load amounted to

NEARLY 60 PER CENT

of the total; that is, only 40 per cent of the total load on the engine was utilized in producing salable goods. Another case showed a dead load of 47 per cent, another of 39 per cent and still another of 26 per cent. The dead loads varied all the way from the lowest to the highest figures named, and were a great surprise to the managers as well as to the engineers.

The dead loads in these cases were obtained by taking indicator diagrams at regular intervals for several days. Then certain departments were alternately run and cut out, and the results averaged practically the same in nearly every instance. A crusade against belt evils reduced the figures in the first instance to about 42 per cent, in the second case it was reduced to 30 per cent, in the third case to 20 per cent and in the fourth case to 18 per cent.

Much can be done toward reducing the dead load by a judicious distribution of the machinery and by the introduction of clutches and clutch pulleys. It is quite possible that the losses referred to could have been reduced another 10 or 15 per cent had the friction clutches been introduced at the proper points.

It seldom pays to jump at conclusions in mechanical matters, and belts, as well as many other devices, require careful study oftentimes and a good stock of sound "horse sense" to be able to locate difficulties and remove them.

Persons who have given the experiment a fair trial are of the opinion that a considerable

SAVING OF FUEL

and other expenses incidental to belt drives is obtained by placing all the belts and shafting in charge of one man. This person may and frequently does have other duties assigned to him, but no other person has anything to do with the maintenance of the belts, pulleys and shafting. If the belt man understands his business as he should, there is no reason why the dead load should not be reduced to the minimum and a considerable saving be thus effected.

Belts are frequently ordered without reference to the conditions under which they are to run, and when received they are unrolled, measured and put upon pulleys with no thought concerning the condition of the leather, some person taking it for granted that a new belt from the dealer or the factory warehouse is in a proper condition to be put on pulleys and is ready for service. The belt is

DRAWN UP TIGHTLY

with belt clamps and laced or sewed and immediately started under a heavy load, and from this time on trouble is not lacking and the belt frequently proves a source of considerable expense before the right thing is done. How much better it would be if some of the painstaking work put upon old belts after the troublesome periods were to be put upon the new belts and many of the troubles common to this form of transmission thus avoided.

Unless great care is exercised in manipulating the clamps, a belt will be stretched more on one side than the other. Consequently, one side will be longer than the other, which generally gives rise to

A VARIETY OF TROUBLES

and attempting to correct one usually produces another. If the belts run off or run to one side of the pulleys, the countershaft is sometimes adjusted to cause it to keep to the centre of the pulleys and this oftentimes produces hot bearings. These are due to the

belt directly, and indirectly to the man who puts it on, in not using good judgment to start with.

Tightening belts increases the friction of the bearings, and consequently the power required to run a mill or factory increases very rapidly when tightening the belts. Tightening the belts not only increases the power consumed, from which no adequate returns can be expected, due to increasing the dead load, but it shortens the life of the belts by bringing about conditions demanding extraordinary treatment which is too often far from beneficial in the long run. Where a belt is rendered as soft and pliable when new as is desired to have it later on, perhaps after the belt has been to a great extent ruined, many of the initial troubles with belts will be avoided, and the subsequent treatment will then be less severe and injurious.

A belt will stretch to some extent when first put on. This cannot be entirely avoided, but it is not wise to attempt to take out all the stretch, as it is called, at any one time, as is frequently done. Considerable time may be saved by so doing, it is true, but it generally happens that the injury to the belt amounts to considerably more than the time saved. When a belt man is employed, the saving of a few minutes now and then is not as important as when skilled workmen are required to leave their work in order to keep the belts in order. A new belt will require

FREQUENT RE-LACING

when properly handled and cared for, because the slack will be removed a little at a time, as it occurs, so as to keep the belt at about the same tension, which should never be greater than is necessary to carry the load without noticeable slipping.

The treatment of new belts consists of an application of warm tallow or a mixture of tallow and oil with a little beeswax added. This is to be rubbed in and the belt permitted to dry thoroughly before being put on the pulleys. Castor-oil dressing may be obtained which is properly prepared for use on belts. This may be applied with a brush or rag while the belt is in motion, if necessary. Belt dressings of any kind should not be applied too liberally, and the belt man who understands his business will not try to treat a belt in from five to ten minutes. Many persons keep pouring on the oil until the desired result is obtained or until the belt begins to behave worse than at first, evidently believing that as soon as the belt has as much oil as it needs all trouble will cease. A house may be painted by pouring the paint over the roof but the distribution will be decidedly poor and the result far from what is desired. It is practically the same with a belt. A very poor and uneven distribution is obtained by pouring on the dressing, which tends to make the belt run worse instead of better, if treated when in motion.

THE RUNNING QUALITY

of the belts depends largely upon the size of the pulleys over which they run, which consequently influences the amount of power it can transmit economically. The speed of the belt also affects its ability to transmit power and has an important influence upon the size of the belt required. It is not a difficult matter to figure out the speed at which a belt should give the best results, but it is when we attempt to apply the result of the calculation that difficulties are oftentimes encountered. When considering the belt only, the more economical speed will be approximately 3,500 feet per minute; that is to say, the greatest power can be transmitted with the least cost, all things considered, at about this speed. It is, however, difficult to obtain this speed in practice, because with a few exceptions one pulley will be found to be smaller, perhaps very much smaller than the other, and as the speed of either the driving or the driven shaft, sometimes both, must remain unchanged, it becomes impossible to get the best speed for the belt, that is, the speed at which we might transmit the greatest number of horse power with the least expense for belting. It is the exception rather than the rule when a belt can be run at the most economical speed from this viewpoint.

A belt drive, to be reliable and free from excessive loss from slipping, should not have too great difference between the diameters of the driving and driven pulleys. Suppose a shaft making 180 revolutions per minute drives a spindle making 2,600 revolutions, and that the driving pulley is 60 inches in diameter, and the spindle 4 inches; it is evident the difference will be too great because the slippage at the small pulley or spindle will be excessive unless the belt be of unusual length and width and very thin, although the speed would be 2,875.5 feet per minute, which in itself would be desirable.

By introducing two countershafts having a 60-inch pulley on the first shaft driving a 40-inch pulley on the second, then a 36-inch driving a 16-inch and a 24-inch driving a 5½-inch pulley on the spindle, the speed of the belts will be respectively, 2,345, 2,543, and 3,815 feet per minute, which more nearly approaches the speed considered best for

ALL ROUND ECONOMY.

When belts are to run close to the ceiling in warm rooms and subjected to the accumulations of dust and dirt, high temperatures and an occasional overload, some allowance must be made, for the tendency of these conditions is to lessen the efficiency of a belt to a considerable extent. When a belt runs in a dry hot place it soon becomes hard and stiff, the surface becoming glossy and the tendency to slip is no less than the tendency to crack, both of which prove highly injurious in a remarkably short time. In a case of this kind, one or two things must be done in order to be able to transmit the same power without further injury to the belt, viz., either a tightener may be employed for the purpose of increasing the tension, thus increasing for a time the degree of adhesion, or the belt must be treated with a good dressing. The latter method is, of course, the best, because in this case the proper degree of adhesion may be secured without increasing the initial stress, which is a desirable thing to do whenever practicable, for it is evident that the lower the unnecessary stresses in a belt can be kept the less friction will there be at the bearings, and, consequently, a corresponding amount of power and fuel will be saved while transmitting the same number of horse power.

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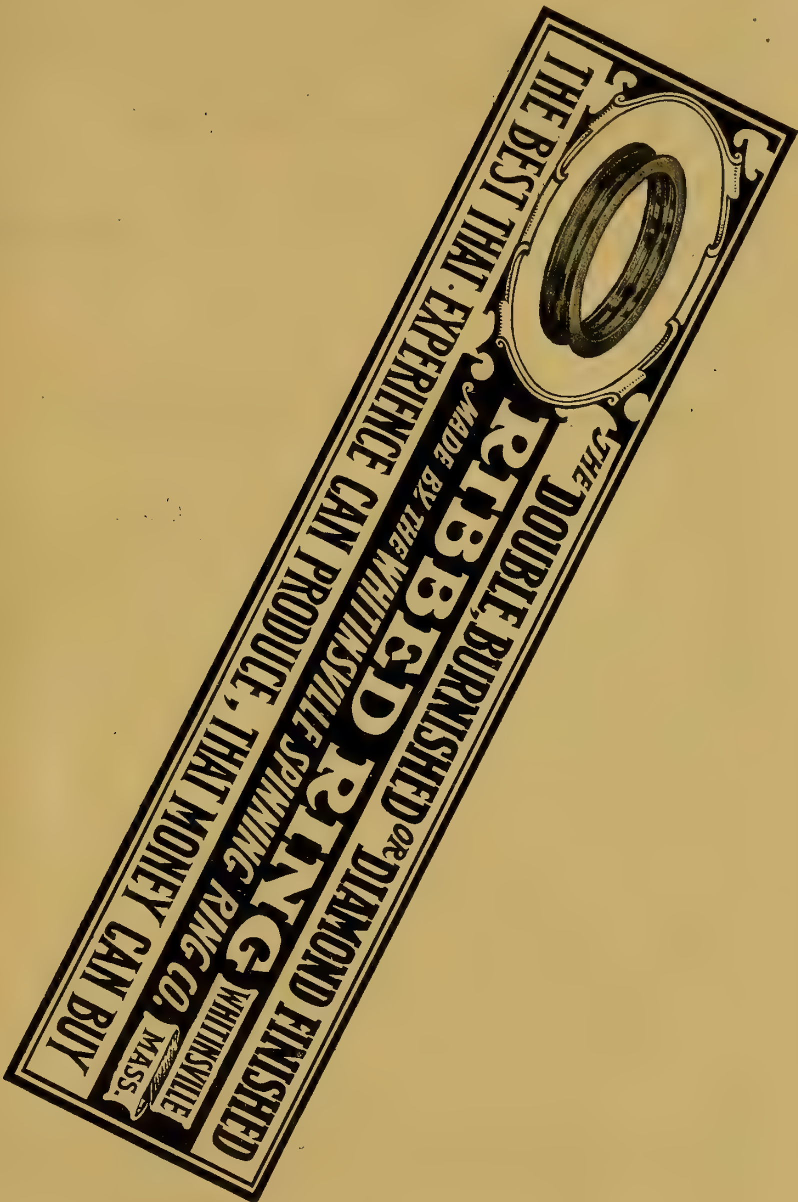
THE DOUBLE, BURNISHED OR DIAMOND FINISHED
RIBBED RING
MADE BY THE WHITINSVILLE SPINNING RING CO.
WHITINSVILLE MASS.
THE BEST THAT EXPERIENCE CAN PRODUCE, THAT MONEY CAN BUY